

New Hampshire Volunteer River Assessment Program

2001

ASHUELOT RIVER

Water Quality Report



February 2003

STATE OF NEW HAMPSHIRE
Volunteer River Assessment Program
2001
ASHUELOT RIVER
Water Quality Report

*STATE OF NEW HAMPSHIRE
DEPARTMENT OF ENVIRONMENTAL SERVICES
6 HAZEN DRIVE
CONCORD, N.H. 03301*

*ROBERT MONACO
ACTING COMMISSIONER*

*HARRY T. STEWART
DIRECTOR
WATER DIVISION*

Prepared by:
Beth L. Malcolm, VRAP Coordinator

February 2003

Printed on Recycled Paper



PREFACE

During the summer of 2001, DES initiated a water quality sampling program to support the development of a total maximum daily load (TMDL) for the Ashuelot River. This work focused on dissolved oxygen. Sampling stations were established in Keene and continued to Winchester. As noted throughout this document, DES recommends continued monitoring for dissolved oxygen and pH. Regarding dissolved oxygen, continued monitoring will benefit the public and DES by providing data before and after implementation of the TMDL.

TABLE OF CONTENTS

1.	ACKNOWLEDGEMENTS.....	1
2.	VOLUNTEER RIVER ASSESSMENT PROGRAM OVERVIEW	2
3.	PROJECT SUMMARY: ASHUELOT RIVER VRAP	3
4.	RESULTS, DISCUSSION, AND RECOMMENDATIONS	3
4.1.	28-Ash: Route 31, Washington, NH.....	1
4.1.1.	Results and Discussion.....	2
4.1.2.	Recommendations	4
4.2.	27-Ash: Mountain Road, Lempster, NH.....	5
4.2.1.	Results and Discussion.....	6
4.2.2.	Recommendations	7
4.3.	24a-Ash: Route 10, Marlow, NH.....	8
4.3.1.	Results and Discussion.....	9
4.3.2.	Recommendations	11
4.4.	23-Ash: Route 10, Gilsum, NH.....	12
4.4.1.	Results and Discussion.....	12
4.4.2.	Recommendations	15
4.5.	20-Ash: Stone Arch Bridge, Keene, NH.....	16
4.5.1.	Results and Discussion.....	17
4.5.2.	Recommendations	19
4.6.	18-Ash: Route 101, Keene, NH	20
4.6.1.	Results and Discussion.....	21
4.6.2.	Recommendations	23
4.7.	16-Ash: Cresson Bridge, Swanzey, NH.....	24
4.7.1.	Results and Discussion.....	25
4.7.2.	Recommendations	27
4.8.	15-Ash: Thompson Bridge, West Swanzey, NH	28
4.8.1.	Results and Discussion.....	29
4.8.2.	Recommendations	31
4.9.	07-Ash: Route 119, Winchester, NH	32
4.9.1.	Results and Discussion.....	33
4.9.2.	Recommendations:	35
4.10.	01-Ash: 147 River Street, Hinsdale, NH	36
4.10.1.	Results and Discussion	37
4.10.2.	Recommendations.....	39

Appendix A: Ashuelot River VRAP 2001 Monitoring Stations
Appendix B: Ashuelot River VRAP 2001 Monitoring Results
Appendix C: VRAP 2001 Parameter and NH Surface Water Quality Standards
Descriptions
Appendix D: Ashuelot VRAP 2001 River Graphs
Appendix E: VRAP 2001 Field Sampling Protocols

Cover Photographs:

Upper left – Double stone-arch bridge (20-Ash) - Keene
Upper right – Cresson bridge (16-Ash) - Swanzey
Lower left – Upstream from Keene WWTF (16D-Ash) - Keene
Lower right – Upstream from Route 63 bridge (2-Ash) - Hinsdale

1. ACKNOWLEDGEMENTS

The New Hampshire Department of Environmental Services-Volunteer River Assessment Program extends sincere thanks to the volunteers in the Ashuelot River watershed during 2001. This report was created solely from the data collected by the volunteers listed, below. It is their time and dedication that not only contributes to the amount of knowledge of rivers and streams in New Hampshire, but also expresses the genuine concern for local water resources.

Fred Bisson
Jim Blake
Patrick Eggleston
Pablo Fleischmann
Jan Lambert
Dan Leavitt
Bill Schenck
Barbara Skuly
Jim Smare
Steve Stepenuck
Al Stoops

2. VOLUNTEER RIVER ASSESSMENT PROGRAM OVERVIEW

The Volunteer River Assessment Program (VRAP) supports watershed organizations in their efforts to monitor river water quality. The primary focus of VRAP is to provide volunteers with river monitoring guidelines, equipment loans, and technical training. DES also incorporates applicable volunteer monitoring results into its evaluation of New Hampshire surface waters. Annual reports for each VRAP river include a summary of monitoring results and recommendations for future water quality sampling. VRAP aims to foster public understanding and stewardship of river systems and to increase available water quality information about New Hampshire rivers and streams.

VRAP loans and maintains water monitoring kits that include meters and supplies for on-station measurement of five basic water quality parameters: water temperature, dissolved oxygen, pH, specific conductance (conductivity), and turbidity. The investigation of these and additional parameters such as nutrients, metals, and *E. coli* is conducted by state water quality personnel and may be augmented by volunteer sampling. Sampling additional parameters comes with the cost of analysis, which can be covered by an assortment of fundraising activities such as association membership fees, special events, and in-kind services (non-monetary contributions from individuals and organizations), and grant writing.

Water quality measurements repeated over time create a picture of the fluctuating conditions in rivers and streams and help to determine where improvements, restoration or preservation may benefit the river and the communities it supports. Water quality results are also used to determine if a river is meeting surface water quality standards. Volunteer monitoring results meeting DES Quality Assurance and Quality Control (QA/QC) requirements supplement the efforts of DES to assess the condition of New Hampshire surface waters. The New Hampshire Surface Water Quality Regulations are available through the DES Public Information Center at www.des.state.nh.us/wmb/Env-Ws1700.pdf or (603) 271-1975.

VRAP typically recommends sampling every other week during the summer, and citizen monitoring groups are encouraged to organize a long-term sampling program in order to begin to determine trends in river conditions. Each year volunteers arrange a sampling schedule and design in cooperation with the VRAP Coordinator. Project designs are created through a review and discussion of existing water quality information, such as known and perceived problem areas or locations of exceptional water quality. The interests, priorities, and resources of the partnership determine monitoring locations, parameters, and frequency.

Each VRAP volunteer must attend an annual training session to receive a demonstration of monitoring protocols and sampling techniques. Training sessions are an opportunity for volunteers to come together and receive an updated version of monitoring techniques. Training sessions are typically conducted outdoors near surface waters for an interactive demonstration. During the training, volunteers have a chance to practice using the VRAP equipment and may also receive instruction in the collection of samples for laboratory

analysis. Training is accomplished in approximately three hours, after which volunteers are certified in the care, calibration, and use of the VRAP equipment.

VRAP groups conduct sampling according to a prearranged monitoring schedule and VRAP protocols. VRAP aims to visit volunteers during scheduled sampling events to verify that volunteers successfully follow the VRAP protocols. If necessary, volunteers are re-trained during the visit, and the group's monitoring coordinator is notified of the result of the verification visit. Volunteer organizations forward water quality results to the VRAP Coordinator for incorporation into an annual report and state water quality assessment activities.

Applicable volunteer data are input to a water quality database, and considered (along with other reliable sources of data) during periodic DES water quality assessments. Assessment results and the methodology used to assess surface waters are published by DES every two years (i.e., Section 305(b) Water Quality Reports) as required by the federal Clean Water Act.

The success of the Ashuelot, Lamprey, Exeter, Sugar, Oyster, Powwow, Cocheco, and other river volunteer programs throughout the state are a direct result of the hard work and dedication of citizen volunteers and many additional people who helped to plan, support, and carry out these monitoring efforts.

3. PROJECT SUMMARY: ASHUELOT RIVER VRAP

Water quality monitoring of the Ashuelot River by the Cheshire County Conservation Commission and the River Watch Network began in 1987. From 1987 to present, volunteers have collected water quality data to better understand the condition of the river. The volunteers were not only interested in the core VRAP water quality monitoring parameters, but were also interested in determining the concentrations of dissolved metals and chloride. These parameters specifically relate to the relatively urban setting of Keene.

During 2001, sampling was focused on ten stations along the river from Washington to Hinsdale. Samples were collected every two to three weeks, beginning in April and concluding in August.

4. RESULTS, DISCUSSION, AND RECOMMENDATIONS

This section includes a description of the Ashuelot River VRAP 2001 monitoring locations and results, a discussion of the results in comparison with New Hampshire surface water quality standards, and recommendations for future sampling and watershed investigations. The VRAP monitoring locations, "stations", are discussed from upstream to downstream (see table in Appendix A). Each station is shown on a map. Results are presented in graphs and text prepared by the VRAP, and tables including all monitoring results from each station are located in Appendix B. The discussion of the results

includes recommendations for future sampling and investigations that will contribute to the assessment of water quality conditions.

The water quality information collected at each station is summarized in a table that provides the reader with an overview of the monitoring activities and results. The table can be used as a quick reference for the reader; results not meeting state water quality criteria do not necessarily indicate a violation of surface water quality standards. The summary table indicates: (1) the number and type of samples collected, (2) the number of samples collected according to quality assurance and quality control requirements, (3) the number of samples not meeting state water quality criteria, (4) the range of the measurements, and (5) abbreviated surface water quality standards.

The presentation and discussion of the volunteer results focuses primarily on three parameters: DO, pH, and *E. coli*. These parameters are the core of the VRAP monitoring system, and have relatively straightforward standards that lend themselves to the assessment of individual results. These results can contribute directly to the determination of fishable and swimmable river and stream conditions, which is often a primary volunteer monitoring goal. Graphs of dissolved oxygen (DO) concentrations and water temperature, and *E. coli* bacteria are included in the discussion, and aide the reader in understanding the results. Appendix C provides descriptions of the water quality parameters analyzed under VRAP during 2001 and the associated New Hampshire surface water quality standards (SWQS) for Class B waters.

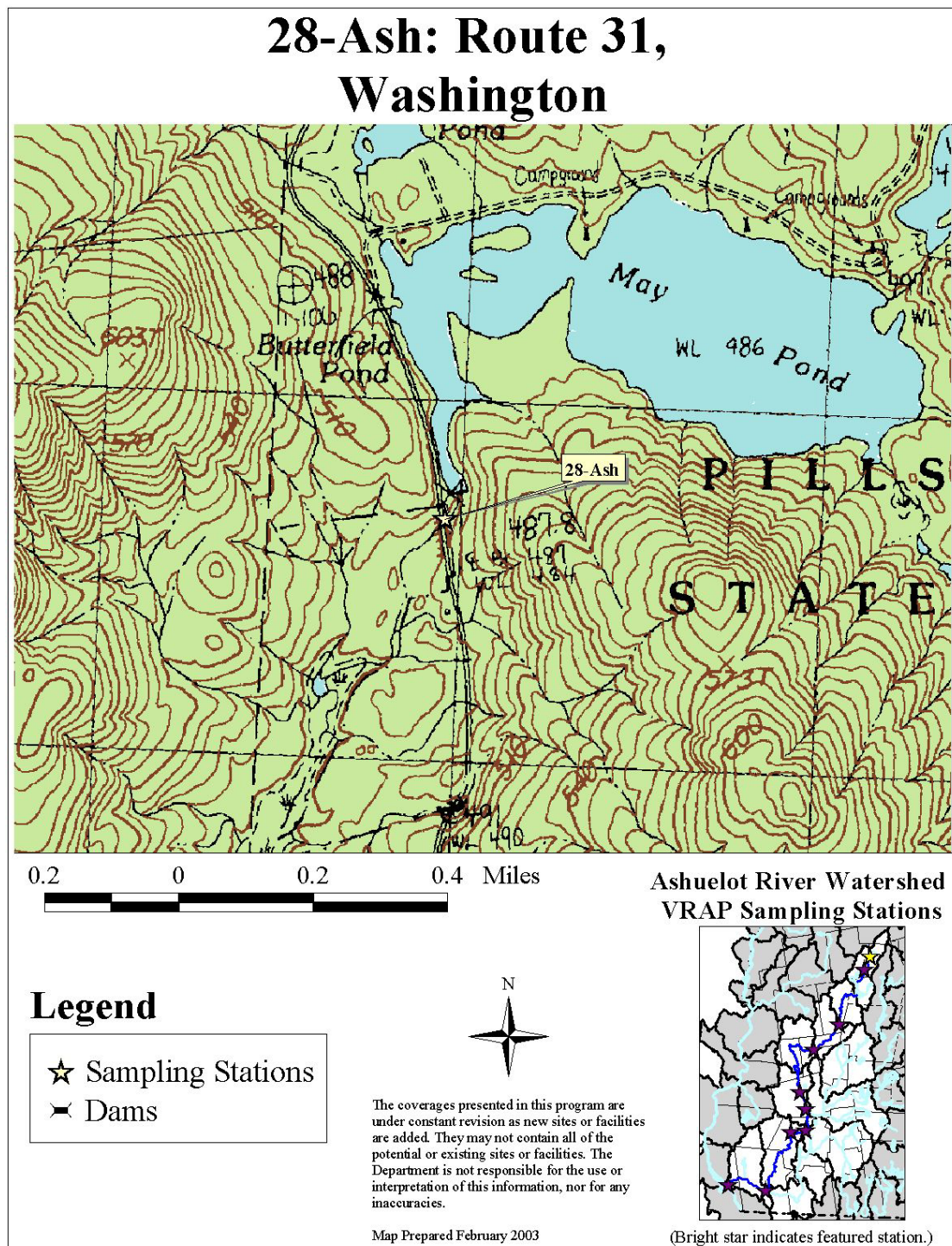
The reader should note that discussion is limited to those parameters at each station that do not meet state criteria, or where more data are necessary. For example, since pH was below the state criteria at 28-Ash, pH will be discussed in detail. However, recommendations are not limited to parameters with results that fall outside state criteria.

VRAP aims to provide a mechanism for citizens to contribute to the ongoing process of surface water quality assessment. Recommendations for future monitoring activities and watershed investigations are included in this report following the results and discussion. Also included are recommendations for improvements in sampling techniques to encourage volunteers to adhere to quality assurance and control measures.

Volunteers are encouraged to sample their rivers and streams on a long-term basis. Much of the information volunteers collect profiles river and stream locations for the first time. Several (five to ten) years of good quality measurements will be needed to begin to decipher water quality trends and the status of rivers and streams relative to the New Hampshire surface water quality standards. Water quality data from the stretch of river sampled by volunteers are presented in graphs in Appendix D. These graphs are included in the report to show how water quality conditions change from upstream to downstream. The current report format will describe water quality conditions on a station-by-station basis.

All results generated by the Ashuelot River VRAP 2001 were collected using the VRAP Field Datasheet and Field Sampling Protocols, 2001 (see Appendix E).

4.1. 28-Ash: Route 31, Washington, NH



4.1.1. Results and Discussion

Seven measurements were made in the field for dissolved oxygen (DO) concentration, pH, and conductivity, while five measurements were made for conductivity using handheld meters (Table 1). Six samples were collected for *E. coli* bacteria and metals, and seven samples were collected for total phosphorus (TP). Four samples were collected for chloride. All measurements and samples met the Quality Assurance and Quality Control (QA/QC) requirements. Four pH measurements and one copper result were below the Class B surface water quality standards. The DO concentration data do not show any apparent DO problems, but these data alone do not accurately characterize DO relative to the surface water quality standards (see explanation in Section 4.1.1.1, below).

Table 1. Monitoring Summary: 28-Ash. VRAP, Year 2001.

Parameter	Samples Collected	Samples Meeting QA/QC Requirements	Acceptable Samples Not Meeting State Criteria	Data Range	Standards*
DO (mg/L)	7	7	0	5.4 - 9.4	>5
DO (% sat.)	0	0	0	NA	>75
pH (std. units)	7	7	4	5.73 - 6.58	6.5-8.0
Turbidity (NTU)	5	5	0	0 - 0.35	<10 above background
Conductivity (µmho/cm)	7	7	0	22.1 - 34.8	NA
<i>E. coli</i> (CTS/100mL)	6	6	0	1 - 56	<406
Total Phosphorus (mg/L)	7	7	0	0.006 - 0.01	NA
Cadmium (µg/L)	6	6	0	<0.25	<0.95
Copper (µg/L)	6	6	1	<2.5 - 6.21	<3.6
Lead (µg/L)	6	6	0	<0.5 - <1.0	<14
Zinc (µg/L)	6	6	0	<9 - 10	<36.2
Chloride (µg/L)	4	4	0	3 - 5	<860,000

*Abbreviated standard values have been used in this table for quick reference. Please see Env-Ws 1700 and RSA 485-A:8 for complete Surface Water Quality Regulations.

4.1.1.1. Dissolved Oxygen

Figure 1 shows dissolved oxygen concentration and water temperature during 2001. Levels of DO sustained above the standards are considered adequate for wildlife populations and other desirable water quality conditions. The Class B New Hampshire

surface water quality standards for DO include a minimum concentration of 5.0 mg/L **and** a minimum daily average of 75 % of saturation. In other words, there are criteria for both concentration and saturation that must be met before the river can be considered as meeting DO standards. Additional sampling is necessary at this station.

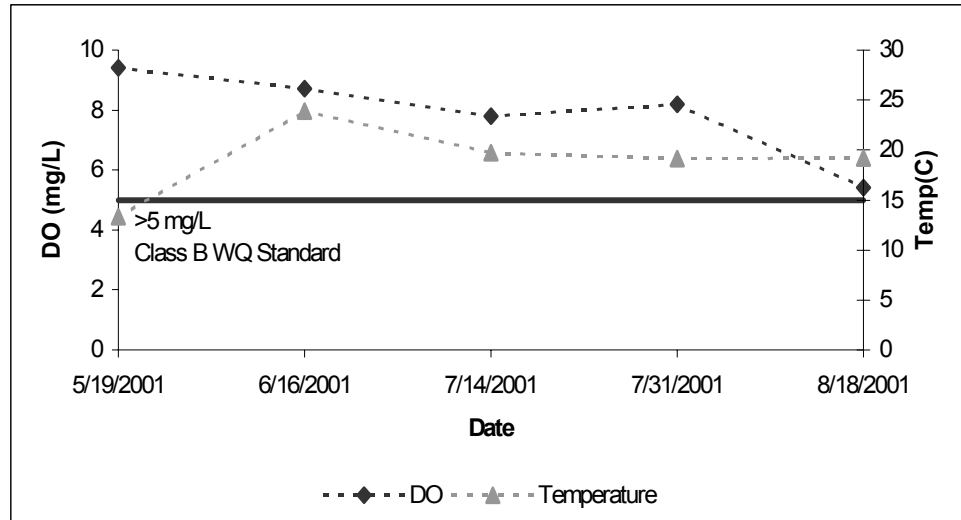


Figure 1. Dissolved Oxygen (DO) Concentration vs. Temperature. Ashuelot River at 28-Ash, Route 31, Washington, NH. VRAP, Year 2001.

4.1.1.2. pH

The pH at this location, ranging from 5.73 to 6.58, was measured below the state standard on four of seven monitoring dates. Station conditions are considered along with pH measurements because of the narrative portion of the pH standard. If the sampling location is influenced by natural conditions, low pH measurements are not considered a violation of surface water quality standards. RSA 485-A:8 states that pH of Class B waters *shall be between 6.5 and 8.0, except when due to natural causes*. The pH of surface waters can be affected by soil, subsurface bedrock, and wetlands near the river or stream. In addition, rain and snow falling in New Hampshire is relatively acidic, which can also affect pH levels. Additional sampling is needed at this station.

4.1.1.3. E. coli

Figure 2 shows instantaneous *E. coli* counts on four dates during 2001.

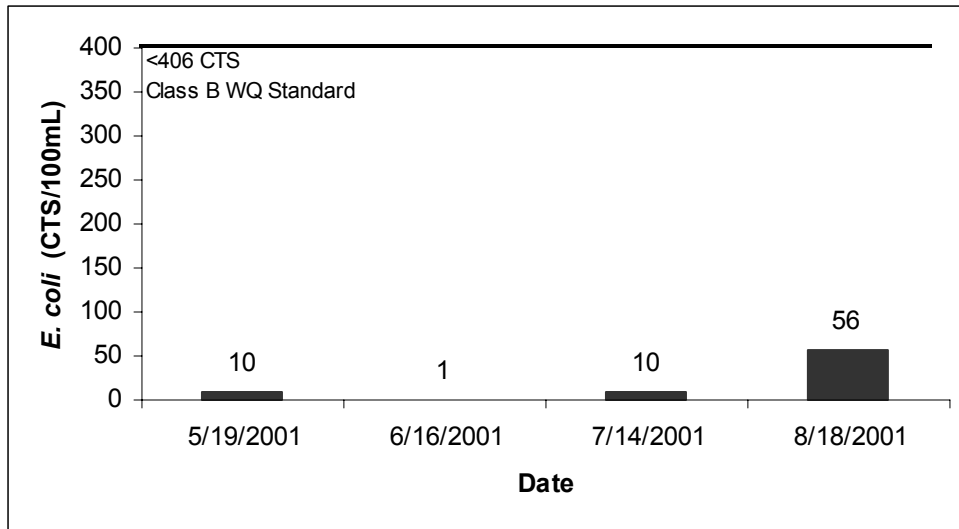


Figure 2. *E. coli* bacteria counts. Ashuelot River at 28-Ash, Route 31, Washington, NH. VRAP, Year 2001.

4.1.2. Recommendations

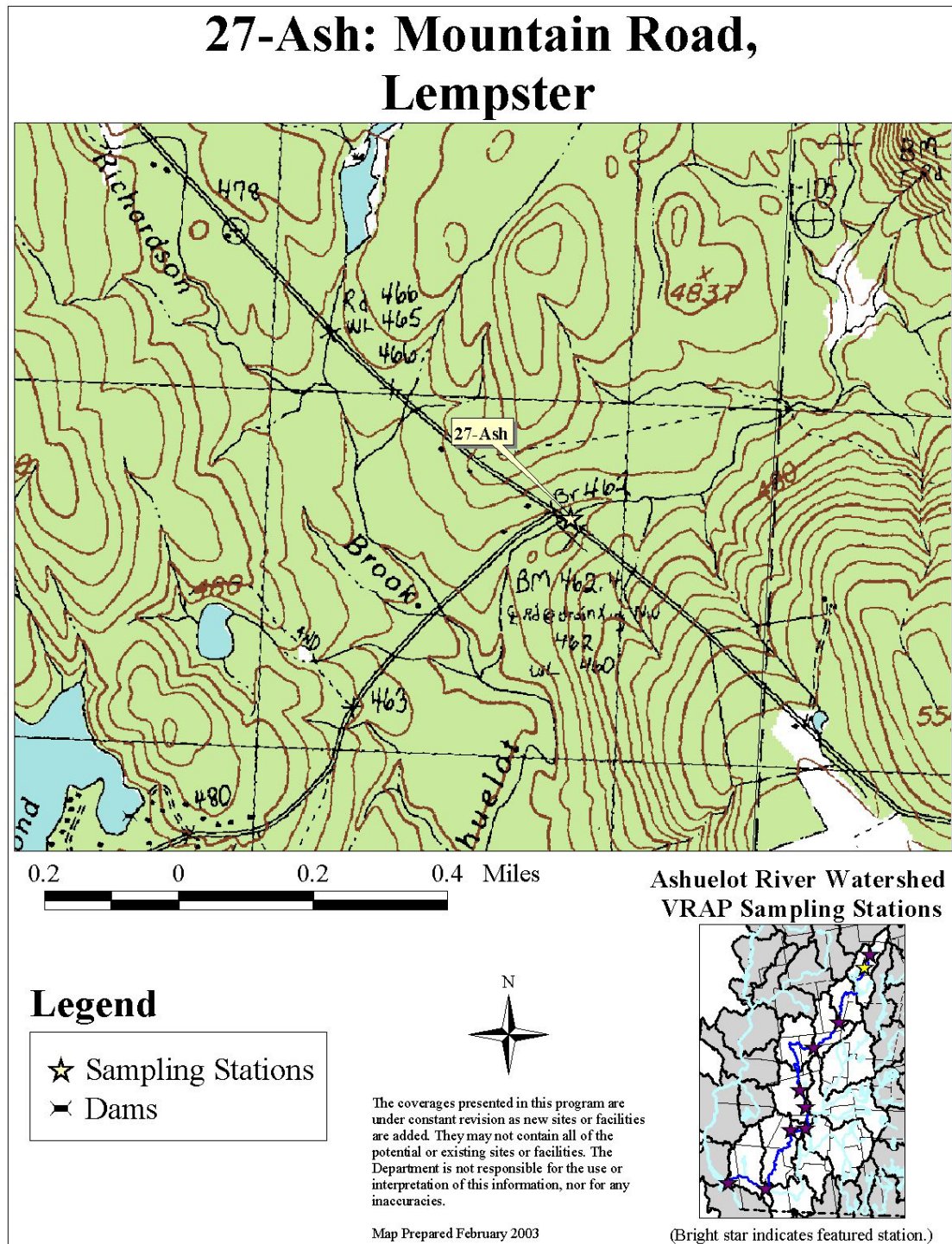
- **Baseline Monitoring:** Volunteers are encouraged to continue sampling for all parameters, especially DO and pH, at this station. More information in the baseline data set will allow for a better understanding of the variations that the river encounters during the year. In addition, this will allow for better documentation of water quality, as related to New Hampshire surface water quality standards.

For an increased understanding of water quality conditions at the time of sampling, volunteers should remember to be specific about the weather conditions and other characteristics of the sampling station.

- ***E. coli*:** Continued *E. coli* sampling at this station is encouraged, as *E. coli* can influence the recreational use of the river. Therefore it is important to monitor *E. coli*, especially where swimming might be expected. Volunteers should continue to collect at least three samples during a 60-day period, which allows the NHDES to determine the geometric mean of *E. coli*. A geometric mean is a type of average that better describes *E. coli* levels relative to the natural characteristics of *E. coli* in water.
- **Dissolved Oxygen:** Measurements should continually be made at this station on a routine basis. This will help document variations in the river, and provide early detection of changes in the river. As previously stated, there are criteria for both concentration **and** saturation that must be met before the river can be considered as meeting DO standards. Volunteers are encouraged to measure DO early in the early morning and during the mid-afternoon hours. This could be done by using a Hydrolab® DataSonde 4a multiprobe, which is an instrument that can collect data

at specific time intervals (e.g., every 1-hour). The instrument can be put in the stream and left alone for a period of several days. The use of this instrument is dependent upon availability, and requires coordination with DES.

4.2. 27-Ash: Mountain Road, Lempster, NH



4.2.1. Results and Discussion

Five measurements were made in the field for dissolved oxygen (DO) concentration and six were made for pH and conductivity using handheld meters (Table 2). All measurements and samples met the Quality Assurance and Quality Control (QA/QC) requirements. All pH measurements were below the Class B water quality standard. The DO concentration data do not show any apparent DO problems, but these data alone do not accurately characterize DO relative to the surface water quality standards (see explanation in Section 4.2.1.1, below).

Table 2. Monitoring Summary: 27-Ash. VRAP, Year 2001.

Parameter	Samples Collected	Samples Meeting QA/QC Requirements	Acceptable Samples Not Meeting State Criteria	Data Range	Standards*
DO (mg/L)	5	5	0	6.5 - 9.7	>5
DO (% sat.)	0	0	0	NA	>75
pH (std. units)	6	6	6	5.47 - 5.96	6.5-8.0
Turbidity (NTU)	0	0	0	NA	<10 above background
Conductivity (µmho/cm)	6	6	0	17.4 - 34.2	NA

*Abbreviated standard values have been used in this table for quick reference. Please see Env-Ws 1700 and RSA 485-A:8 for complete Surface Water Quality Regulations.

4.2.1.1. Dissolved Oxygen

Figure 3 shows dissolved oxygen concentration and water temperature during 2001. Levels of DO sustained above the standards are considered adequate for wildlife populations and other desirable water quality conditions. The Class B New Hampshire surface water quality standards for DO include a minimum concentration of 5.0 mg/L **and** a minimum daily average of 75 % of saturation. In other words, there are criteria for both concentration and saturation that must be met before the river can be considered as meeting DO standards. Additional sampling is necessary at this station.

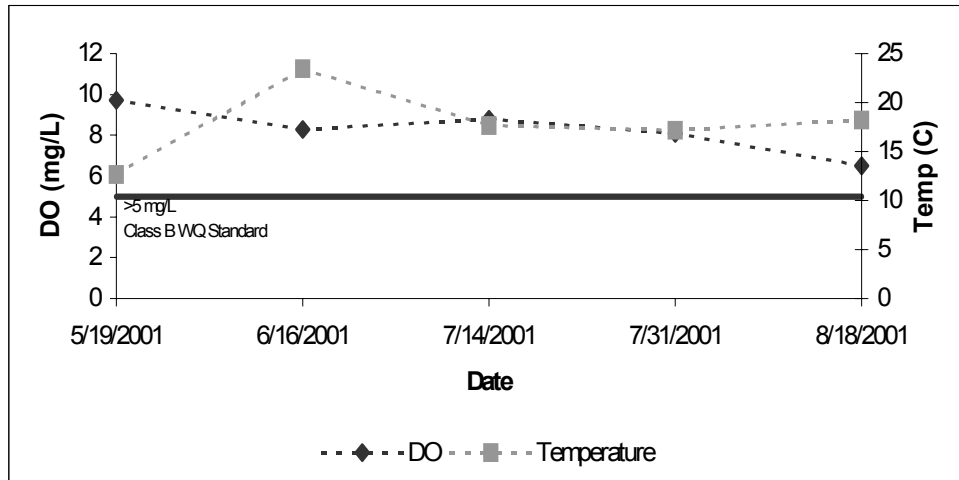


Figure 3. Dissolved Oxygen (DO) Concentration vs. Temperature. Ashuelot River at 27-Ash, Mountain Road, Lempster, NH. VRAP, Year 2001.

4.2.1.2. pH

The pH at this location, ranging from 5.47 to 5.96, was measured below the state standard on all six monitoring dates. Station conditions are considered along with pH measurements because of the narrative portion of the pH standard. If the sampling location is influenced by natural conditions, low pH measurements are not considered a violation of surface water quality standards. RSA 485-A:8 states that pH of Class B waters *shall be between 6.5 and 8.0, except when due to natural causes*. The pH of surface waters can be affected by soil, subsurface bedrock, and wetlands near the river or stream. In addition, rain and snow falling in New Hampshire is relatively acidic, which can also affect pH levels. Additional sampling is needed at this station.

4.2.2. Recommendations

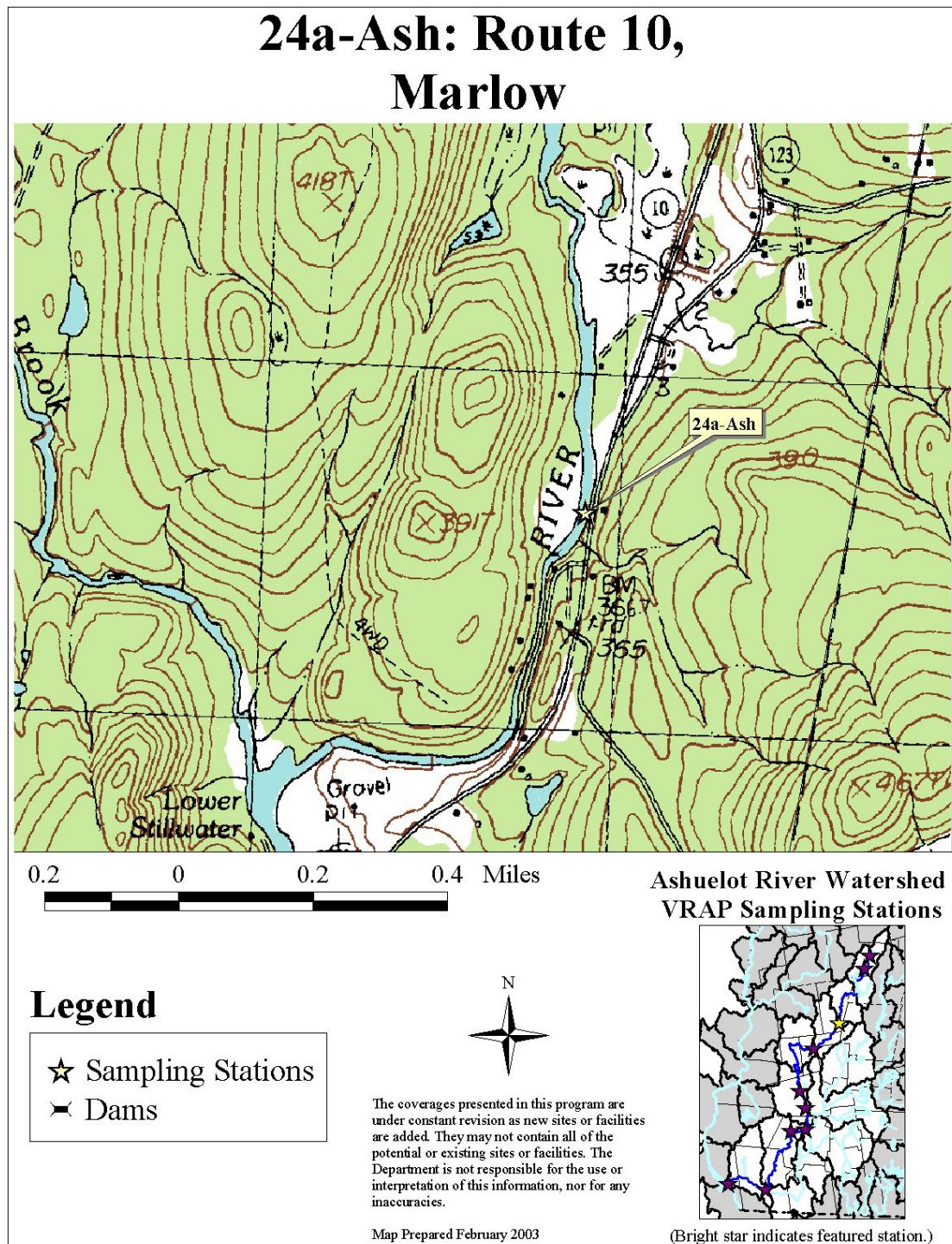
- **Baseline Monitoring:** Volunteers are encouraged to continue sampling for all parameters, especially DO and pH, at this station. More information in the baseline data set will allow for a better understanding of the variations that the river encounters during the year. In addition, this will allow for better documentation of water quality, as related to New Hampshire surface water quality standards.

For an increased understanding of water quality conditions at the time of sampling, volunteers should remember to be specific about the weather conditions and other characteristics of the sampling station.

- **Dissolved Oxygen:** Measurements should continually be made at this station on a routine basis. This will help document variations in the river, and provide early detection of changes in the river. As previously stated, there are criteria for both concentration **and** saturation that must be met before the river can be considered as meeting DO standards. Volunteers are encouraged to measure DO early in the early morning and during the mid-afternoon hours. This could be done by using a

Hydrolab® DataSonde 4a multiprobe, which is an instrument that can collect data at specific time intervals (e.g., every 1-hour). The instrument can be put in the stream and left alone for a period of several days. The use of this instrument is dependent upon availability, and requires coordination with DES.

4.3. 24a-Ash: Route 10, Marlow, NH



4.3.1. Results and Discussion

Six measurements were made in the field for pH and conductivity, while five measurements for dissolved oxygen (DO) concentration and three for turbidity were made using handheld meters (Table 3). Four samples were collected for *E. coli* bacteria, metals, and chloride; six samples were collected for total phosphorus (TP). All measurements and samples met the Quality Assurance and Quality Control (QA/QC) requirements. All pH measurements were below the Class B surface water quality standards. The DO concentration data do not show any apparent DO problems, but these data alone do not accurately characterize DO relative to the surface water quality standards (see explanation in Section 4.3.1.1, below).

Table 3. Monitoring Summary: 24a-Ash, VRAP, Year 2001.

Parameter	Samples Collected	Samples Meeting QA/QC Requirements	Acceptable Samples Not Meeting State Criteria	Data Range	Standards*
DO (mg/L)	5	5	0	7.5 - 10.2	>5
DO (% sat.)	0	0	0	NA	>75
pH (std. units)	6	6	6	5.61 - 6.14	6.5-8.0
Turbidity (NTU)	3	3	0	0.5 - 0.75	<10 above background
Conductivity (µmho/cm)	6	6	0	20.1 - 43.8	NA
<i>E. coli</i> (CTS/100mL)	4	4	0	6 - 19	<406
Total Phosphorus (mg/L)	6	6	0	0.005 - 0.015	NA
Cadmium (µg/L)	4	4	0	<0.25	<0.95
Copper (µg/L)	4	4	0	<2.5 - 2.82	<3.6
Lead (µg/L)	4	4	0	<0.5 - 1.33	<14
Zinc (µg/L)	4	4	0	<9	<36.2
Chloride (µg/L)	4	4	0	5	<860,000

*Abbreviated standard values have been used in this table for quick reference. Please see Env-Ws 1700 and RSA 485-A:8 for complete Surface Water Quality Regulations.

4.3.1.1. Dissolved Oxygen

Figure 4 shows dissolved oxygen concentration and water temperature during 2001. Levels of DO sustained above the standards are considered adequate for wildlife populations and other desirable water quality conditions. The instantaneous DO standard (5.0 mg/L) was not met on several occasions, which indicates a potential problem. The

Class B New Hampshire surface water quality standards for DO include a minimum concentration of 5.0 mg/L **and** a minimum daily average of 75 % of saturation. In other words, there are criteria for both concentration and saturation that must be met before the river can be considered as meeting DO standards.

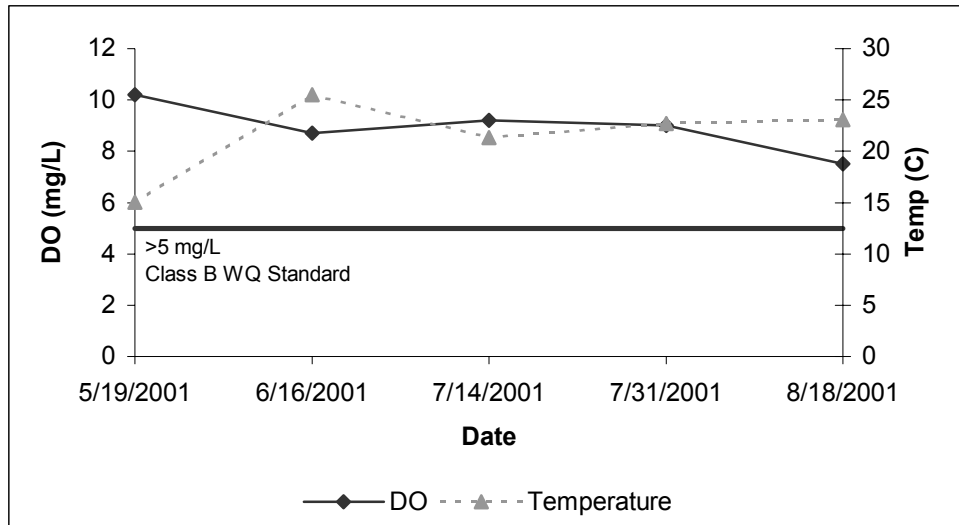


Figure 4. Dissolved Oxygen (DO) Concentration vs. Temperature. Ashuelot River at 24a-Ash, Route 10, Marlow, NH. VRAP, Year 2001.

4.3.1.2. pH

The pH at this location, ranging from 5.61 to 6.14, was measured below the state standard on all monitoring dates. Station conditions are considered along with pH measurements because of the narrative portion of the pH standard. If the sampling location is influenced by natural conditions, low pH measurements are not considered a violation of surface water quality standards. RSA 485-A:8 states that pH of Class B waters *shall be between 6.5 and 8.0, except when due to natural causes*. The pH of surface waters can be affected by soil, subsurface bedrock, and wetlands near the river or stream. In addition, rain and snow falling in New Hampshire is relatively acidic, which can also affect pH levels. Additional sampling is needed at this station.

4.3.1.3. E. coli

Figure 5 shows instantaneous *E. coli* counts on four dates during 2001.

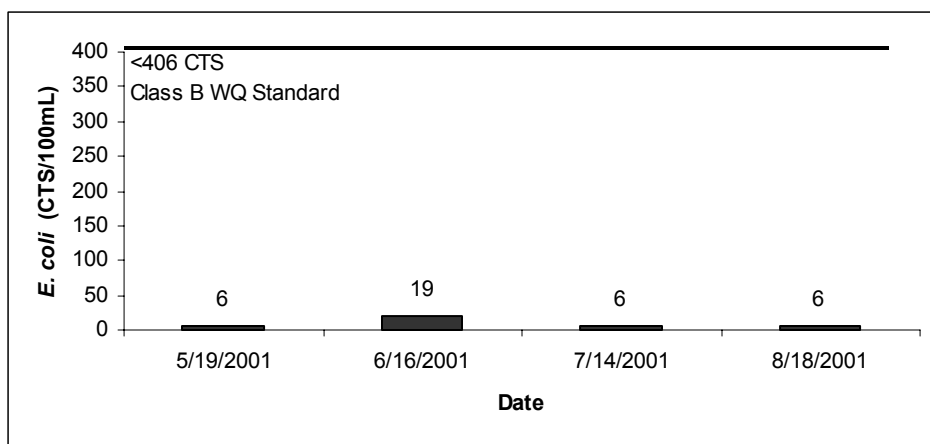


Figure 5. *E. coli* Bacteria Counts. Ashuelot River at 24a-Ash, Route 10, Marlow, NH. VRAP, Year 2001.

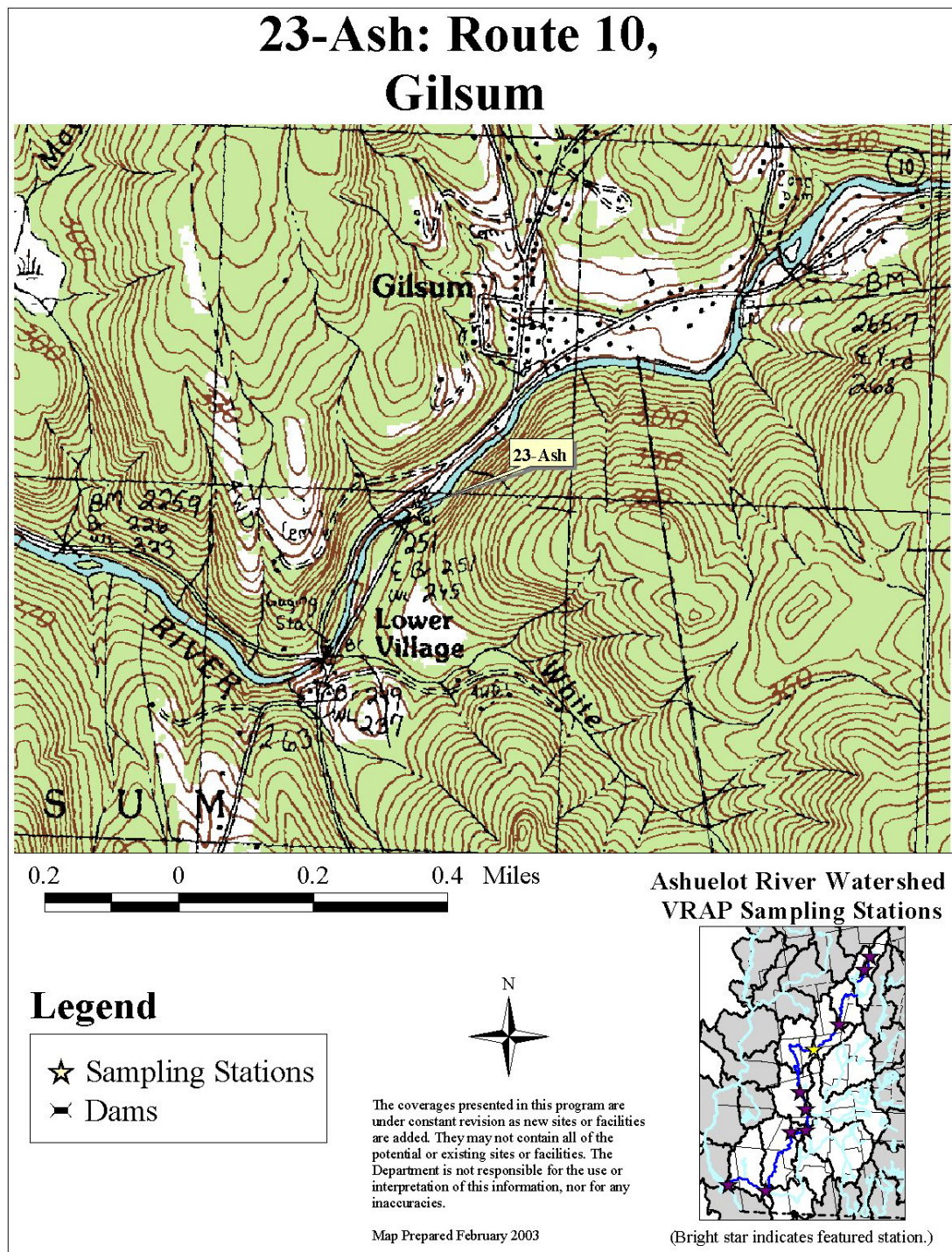
4.3.2. Recommendations

- **Baseline Monitoring:** Volunteers are encouraged to continue sampling for all parameters, especially DO and pH, at this station. More information in the baseline data set will allow for a better understanding of the variations that the river encounters during the year. In addition, this will allow for better documentation of water quality, as related to New Hampshire surface water quality standards.

For an increased understanding of water quality conditions at the time of sampling, volunteers should remember to be specific about the weather conditions and other characteristics of the sampling station.

- ***E. coli*:** Continued *E. coli* sampling at this station is encouraged, as *E. coli* can influence the recreational use of the river. Therefore it is important to monitor *E. coli*, especially where swimming might be expected. Volunteers should continue to collect at least three samples during a 60-day period, which allows the NHDES to determine the geometric mean of *E. coli*. A geometric mean is a type of average that better describes *E. coli* levels relative to the natural characteristics of *E. coli* in water.
- **Dissolved Oxygen:** Measurements should continually be made at this station on a routine basis. This will help document variations in the river, and track the current potential problem that occurred during August. As previously stated, there are criteria for both concentration **and** saturation that must be met before the river can be considered as meeting DO standards. Volunteers are encouraged to measure DO early in the early morning and during the mid-afternoon hours. This could be done by using a Hydrolab® DataSonde 4a multiprobe, which is an instrument that can collect data at specific time intervals (e.g., every 1-hour). The instrument can be put in the stream and left alone for a period of several days. The use of this instrument is dependent upon availability, and requires coordination with DES.

4.4. 23-Ash: Route 10, Gilsum, NH



4.4.1. Results and Discussion

Seven measurements were made in the field for pH and conductivity, while five measurements for dissolved oxygen (DO) concentration and four for turbidity were made using handheld meters (Table 4). Five samples were collected for *E. coli* bacteria and chloride, and four samples were collected for total phosphorus (TP) and metals. Six samples were collected for chlorides. All measurements and samples met the Quality Assurance and Quality Control (QA/QC) requirements. Three pH measurements were below the Class B surface water quality standards. The DO concentration data do not show any apparent DO problems, but these data alone do not accurately characterize DO relative to the surface water quality standards (see explanation in Section 4.4.1.1, below).

Table 4. Monitoring Summary: 23-Ash. VRAP, Year 2001.

Parameter	Samples Collected	Samples Meeting QA/QC Requirements	Acceptable Samples Not Meeting State Criteria	Data Range	Standards*
DO (mg/L)	5	5	0	8.4 - 10.1	>5
DO (% sat.)	0	0	0	NA	>75
pH (std. units)	7	7	3	6.16 - 6.58	6.5-8.0
Turbidity (NTU)	4	4	0	0.4 - 0.55	<10 above background
Conductivity (µmho/cm)	7	7	0	21.6 - 70.3	NA
<i>E. coli</i> (CTS/100mL)	5	5	0	8 - 33	<406
Total Phosphorus (mg/L)	4	4	0	<0.005 - 0.01	NA
Cadmium (µg/L)	4	4	0	<0.25	<0.95
Copper (µg/L)	4	4	0	<2.5 - 2.5	<3.6
Lead (µg/L)	4	4	0	<1.0 - 1.88	<14
Zinc (µg/L)	4	4	0	<9 - 9	<36.2
Chloride (µg/L)	5	5	0	5 - 10	<860,000

*Abbreviated standard values have been used in this table for quick reference. Please see Env-Ws 1700 and RSA 485-A:8 for complete Surface Water Quality Regulations.

4.4.1.1. Dissolved Oxygen

Figure 6 shows dissolved oxygen concentration and water temperature during 2001. Levels of DO sustained above the standards are considered adequate for wildlife populations and other desirable water quality conditions. The Class B New Hampshire surface water quality standards for DO include a minimum concentration of 5.0 mg/L **and** a minimum daily average of 75 % of saturation. In other words, there are criteria for

both concentration and saturation that must be met before the river can be considered as meeting DO standards.

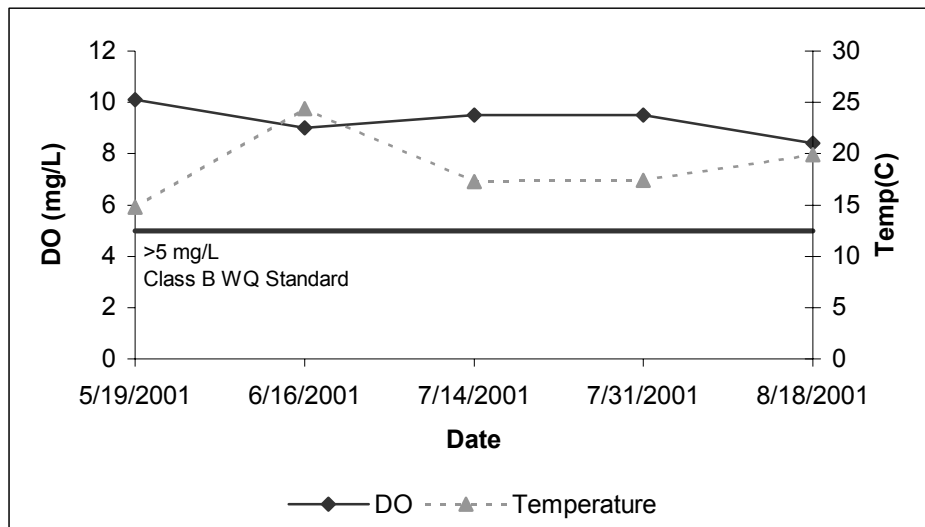


Figure 6. Dissolved Oxygen (DO) Concentration vs. Temperature. Ashuelot River at 23-Ash, Route 10, Gilsum, NH. VRAP, Year 2001.

4.4.1.2. pH

The pH at this location, ranging from 6.16 – 6.58, was measured below the state standard range on three of seven monitoring dates. Station conditions are considered along with pH measurements because of the narrative portion of the pH standard. If the sampling location is influenced by natural conditions, low pH measurements are not considered a violation of surface water quality standards. RSA 485-A:8 states that pH of Class B waters *shall be between 6.5 and 8.0, except when due to natural causes*. The pH of surface waters can be affected by soil, subsurface bedrock, and wetlands near the river or stream. In addition, rain and snow falling in New Hampshire is relatively acidic, which can also affect pH levels. Additional sampling is needed at this station.

4.4.1.3. E. coli

Figure 7 shows the instantaneous *E. coli* counts during summer 2001. Volunteer sampling since 1998 has indicated that elevated bacteria levels in the Ashuelot River are usually associated with rain events, which has prompted an interest among volunteers to better understand the relationship between rain and bacteria levels.

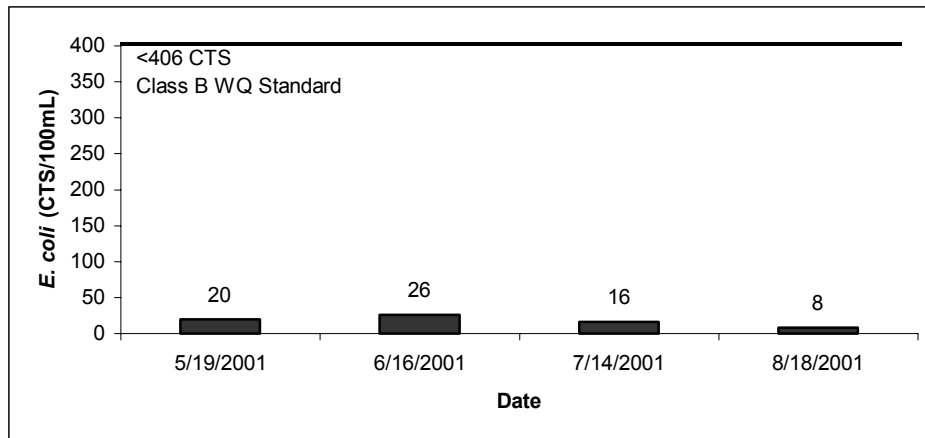


Figure 7. *E. coli* Bacteria Counts. Ashuelot River at 23-Ash, Route 10, Gilsum, NH. VRAP, Year 2001.

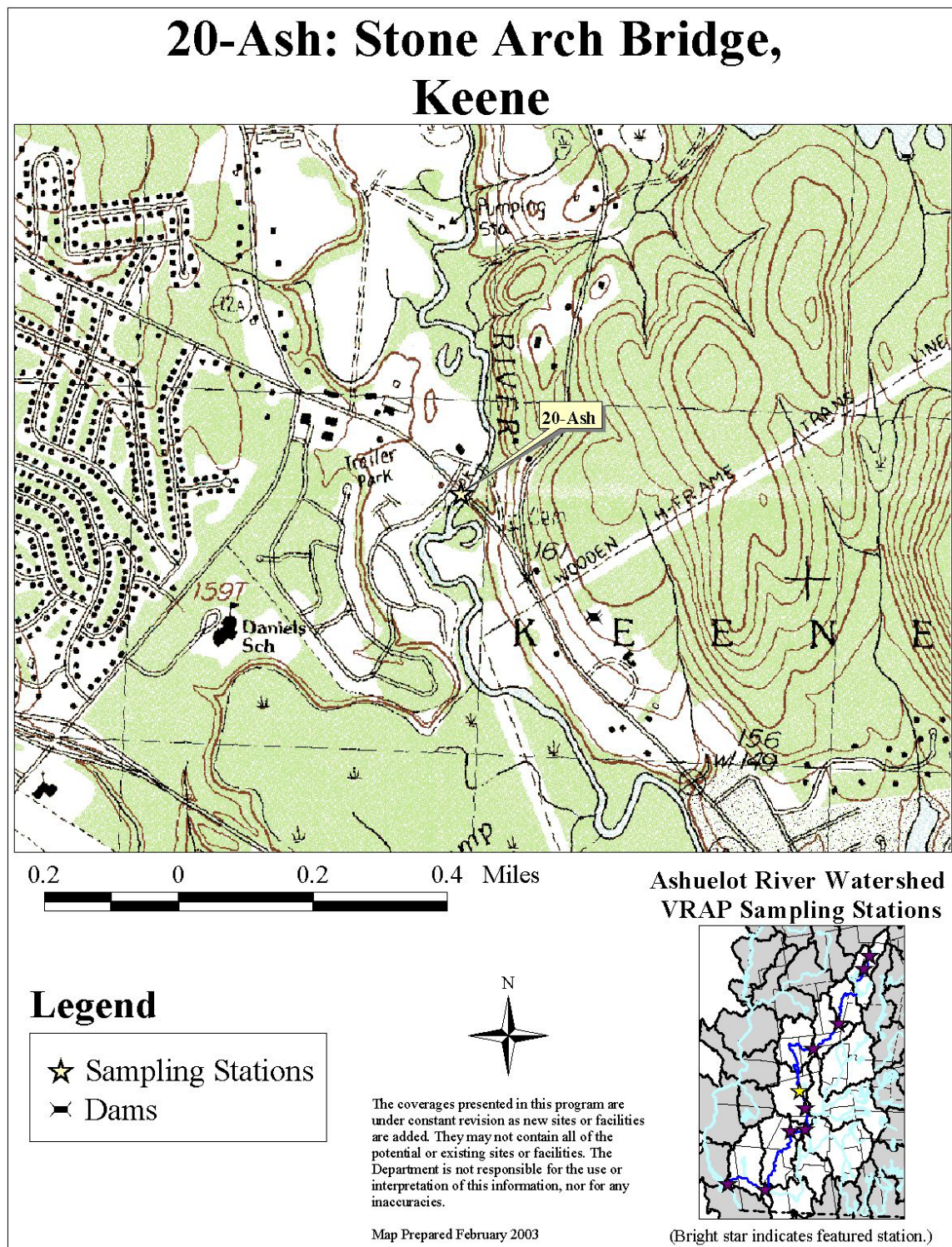
4.4.2. Recommendations

- **Baseline Monitoring:** Volunteers are encouraged to continue sampling for all parameters, especially DO and pH, at this station. More information in the baseline data set will allow for a better understanding of the variations that the river encounters during the year. In addition, this will allow for better documentation of water quality, as related to New Hampshire surface water quality standards.

For an increased understanding of water quality conditions at the time of sampling, volunteers should remember to be specific about the weather conditions and other characteristics of the sampling station.

- ***E. coli*:** Continued *E. coli* sampling at this station is encouraged, as *E. coli* can influence the recreational use of the river. Therefore it is important to monitor *E. coli*, especially where swimming might be expected. Volunteers should continue to collect at least three samples during a 60-day period, which allows the NHDES to determine the geometric mean of *E. coli*. A geometric mean is a type of average that better describes *E. coli* levels relative to the natural characteristics of *E. coli* in water.
- **Dissolved Oxygen:** Measurements should continually be made at this station on a routine basis. This will help document variations in the river, and track the current potential problem that occurred during August. As previously stated, there are criteria for both concentration **and** saturation that must be met before the river can be considered as meeting DO standards. Volunteers are encouraged to measure DO early in the early morning and during the mid-afternoon hours. This could be done by using a Hydrolab® DataSonde 4a multiprobe, which is an instrument that can collect data at specific time intervals (e.g., every 1-hour). The instrument can be put in the stream and left alone for a period of several days. The use of this instrument is dependent upon availability, and requires coordination with DES.

4.5. 20-Ash: Stone Arch Bridge, Keene, NH



4.5.1. Results and Discussion

Six measurements were made in the field for pH and conductivity, while five measurements were made for dissolved oxygen (DO) concentration, four for turbidity, and three for DO saturation using handheld meters (Table 5). Five samples were collected for *E. coli* bacteria and metals, and four samples were collected for total phosphorus (TP) and chloride. All measurements and samples met the Quality Assurance and Quality Control (QA/QC) requirements. All pH measurements were below the Class B surface water quality standards. One measurement for DO % saturation was lower than 75%, but this does not necessarily indicate a DO problem (see explanation in Section 4.5.1.1, below).

Table 5. Monitoring Summary: 20-Ash. VRAP, Year 2001.

Parameter	Samples Collected	Samples Meeting QA/QC Requirements	Acceptable Samples Not Meeting State Criteria	Data Range	Standards*
DO (mg/L)	5	5	0	5.96 - 9.3	>5
DO (% sat.)	3	3	1	66.2 - 88.6	>75
pH (std. units)	6	6	6	5.55 - 6.44	6.5-8.0
Turbidity (NTU)	4	4	0	0.5 - 0.9	<10 above background
Conductivity (µmho/cm)	6	6	0	23.7 - 90.9	NA
<i>E. coli</i> (CTS/100mL)	5	5	0	6 - 75	<406
Total Phosphorus (mg/L)	4	4	0	0.007 - 0.013	NA
Cadmium (µg/L)	5	5	0	<0.25	<0.95
Copper (µg/L)	5	5	0	<2.5 - 2.95	<3.6
Lead (µg/L)	5	5	0	<0.5 - <1.0	<14
Zinc (µg/L)	5	5	0	<9	<36.2
Chloride (µg/L)	4	4	0	5 - 10	<860,000

*Abbreviated standard values have been used in this table for quick reference. Please see Env-Ws 1700 and RSA 485-A:8 for complete Surface Water Quality Regulations.

4.5.1.1. Dissolved Oxygen

Figure 8 shows dissolved oxygen concentration and water temperature during 2001. Levels of DO sustained above the standards are considered adequate for wildlife

populations and other desirable water quality conditions. The Class B New Hampshire surface water quality standards for DO include a minimum concentration of 5.0 mg/L **and** a minimum daily average of 75 % of saturation. In other words, there are criteria for both concentration and saturation that must be met before the river can be considered as meeting DO standards.

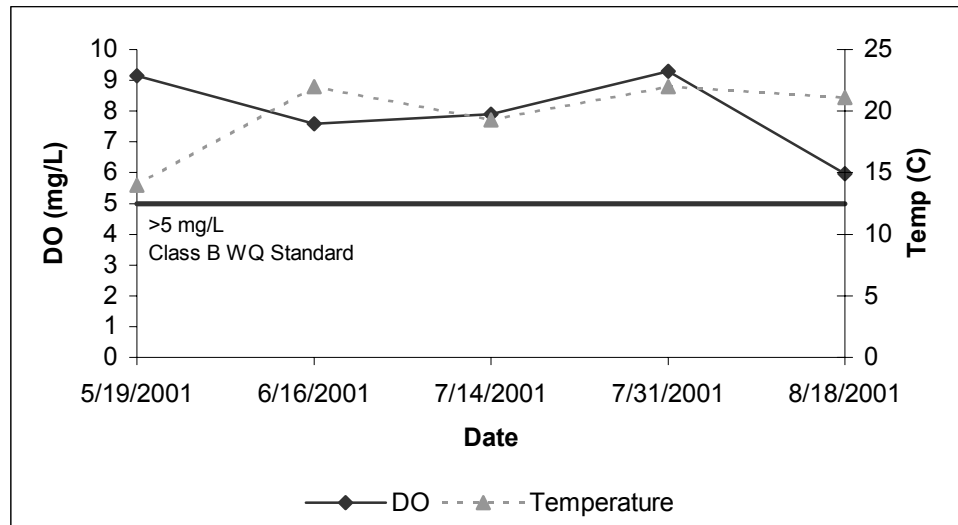


Figure 8. Dissolved Oxygen (DO) Concentration vs. Temperature. Ashuelot River at 20-Ash, Stone Arch bridge, Keene, NH. VRAP, Year 2001.

4.5.1.2. pH

The pH at this location, ranging from 5.55 to 6.44, was measured below the state standard on all monitoring dates. Station conditions are considered along with pH measurements because of the narrative portion of the pH standard. If the sampling location is influenced by natural conditions, low pH measurements are not considered a violation of surface water quality standards. RSA 485-A:8 states that pH of Class B waters *shall be between 6.5 and 8.0, except when due to natural causes*. The pH of surface waters can be affected by soil, subsurface bedrock, and wetlands near the river or stream. In addition, rain and snow falling in New Hampshire is relatively acidic, which can also affect pH levels. Additional sampling is needed at this station.

4.5.1.3. E. coli

Figure 9 shows instantaneous *E. coli* counts on four dates during 2001.

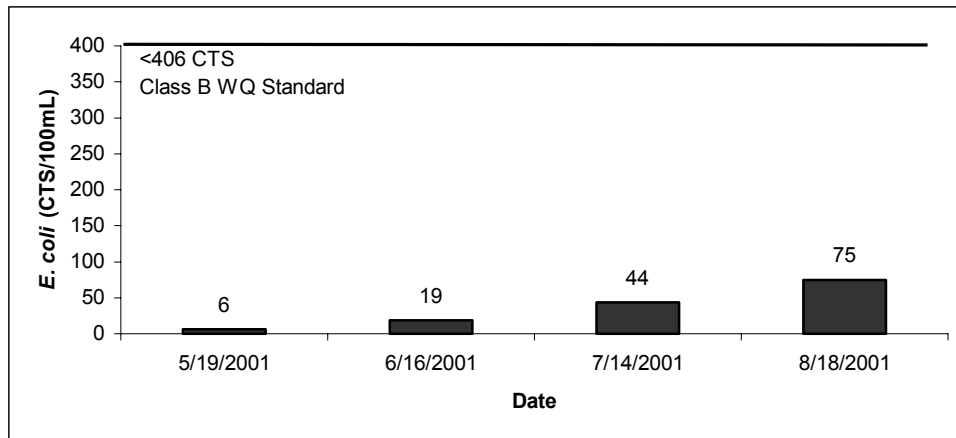


Figure 9. *E. coli* bacteria counts. Ashuelot River at 20-Ash, Stone Arch bridge, Keene, NH. VRAP, Year 2001.

4.5.2. Recommendations

- **Baseline Monitoring:** Volunteers are encouraged to continue sampling for all parameters, especially DO and pH, at this station. More information in the baseline data set will allow for a better understanding of the variations that the river encounters during the year. In addition, this will allow for better documentation of water quality, as related to New Hampshire surface water quality standards.

For an increased understanding of water quality conditions at the time of sampling, volunteers should remember to be specific about the weather conditions and other characteristics of the sampling station.

- ***E. coli*:** Continued *E. coli* sampling at this station is encouraged, as *E. coli* can influence the recreational use of the river. Therefore it is important to monitor *E. coli*, especially where swimming might be expected. Volunteers should continue to collect at least three samples during a 60-day period, which allows the NHDES to determine the geometric mean of *E. coli*. A geometric mean is a type of average that better describes *E. coli* levels relative to the natural characteristics of *E. coli* in water.
- **Dissolved Oxygen:** Measurements should continually be made at this station on a routine basis. This will help document variations in the river. As previously stated, there are criteria for both concentration **and** saturation that must be met before the river can be considered as meeting DO standards. Volunteers are encouraged to measure DO early in the early morning and during the mid-afternoon hours. This could be done by using a Hydrolab® DataSonde 4a multiprobe, which is an instrument that can collect data at specific time intervals (e.g., every 1-hour). The instrument can be put in the stream and left alone for a period of several days. The use of this instrument is dependent upon availability, and requires coordination with DES.

18-Ash: Route 101, Keene

Legend

- ★ Sampling Stations
- ✕ Dams

The coverages presented in this program are under constant revision as new sites or facilities are added. They may not contain all of the potential or existing sites or facilities. The Department is not responsible for the use or interpretation of this information, nor for any inaccuracies.

Map Prepared February 2003

(Bright star indicates featured station.)

4.6.1. Results and Discussion

Six measurements were made in the field for pH and conductivity, while five measurements were made for dissolved oxygen (DO) concentration, and three for turbidity and DO saturation using handheld meters (Table 6). Three samples were collected for *E. coli* bacteria and metals, four samples were collected for total phosphorus (TP), and five samples were collected for chloride. All measurements and samples met the Quality Assurance and Quality Control (QA/QC) requirements. Five pH measurements were below the Class B surface water quality standards. One measurement for DO % saturation was lower than 75%, but this does not necessarily indicate a DO problem (see explanation in Section 4.6.1.1, below). One *E. coli* sample was greater than the Class B standard.

Table 6. Monitoring Summary: 18-Ash. VRAP, Year 2001.

Parameter	Samples Collected	Samples Meeting QA/QC Requirements	Acceptable Samples Not Meeting State Criteria	Data Range	Standards*
DO (mg/L)	5	5	0	6.15 - 8.96	>5
DO (% sat.)	3	3	1	70.7 - 87.7	>75
pH (std. units)	6	6	5	6.24 - 6.54	6.5-8.0
Turbidity (NTU)	3	3	0	0.9 - 1	<10 above background
Conductivity (µmho/cm)	6	6	0	26.2 - 202.9	NA
<i>E. coli</i> (CTS/100mL)	3	3	1	51 - 1080	<406
Total Phosphorus (mg/L)	4	4	0	0.007 - 0.013	NA
Cadmium (µg/L)	3	3	0	<0.25 - 0.47	<0.95
Copper (µg/L)	3	3	0	<2.5	<3.6
Lead (µg/L)	3	3	0	<1.0 - 1.668	<14
Zinc (µg/L)	3	3	0	<9	<36.2
Chloride (µg/L)	5	5	0	10 - 40	<860,000

*Abbreviated standard values have been used in this table for quick reference. Please see Env-Ws 1700 and RSA 485-A:8 for complete Surface Water Quality Regulations.

** Metals standards represent fresh water acute criteria.

4.6.1.1. Dissolved Oxygen

Figure 10 shows dissolved oxygen concentration and water temperature during 2001. Levels of DO sustained above the standards are considered adequate for wildlife populations and other desirable water quality conditions. The Class B New Hampshire surface water quality standards for DO include a minimum concentration of 5.0 mg/L **and** a minimum daily average of 75 % of saturation. In other words, there are criteria for both concentration and saturation that must be met before the river can be considered as meeting DO standards.

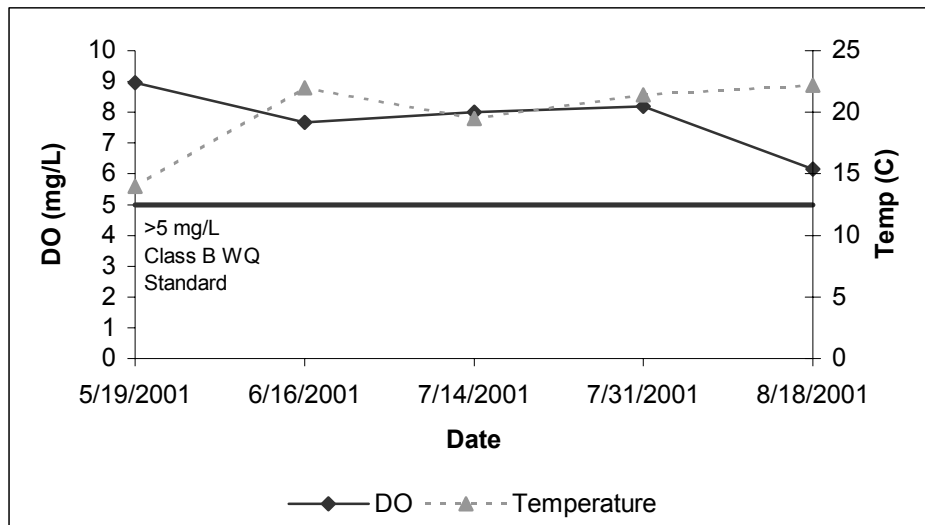


Figure 10. Dissolved Oxygen (DO) Concentration vs. Temperature. Ashuelot River at 18-Ash, Route 101, Keene, NH. VRAP, Year 2000.

4.6.1.2. pH

The pH at this location, ranging from 6.24 to 6.54, was measured below the state standard on five of six monitoring dates. Station conditions are considered along with pH measurements because of the narrative portion of the pH standard. If the sampling location is influenced by natural conditions, low pH measurements are not considered a violation of surface water quality standards. RSA 485-A:8 states that pH of Class B waters *shall be between 6.5 and 8.0, except when due to natural causes*. The pH of surface waters can be affected by soil, subsurface bedrock, and wetlands near the river or stream. In addition, rain and snow falling in New Hampshire is relatively acidic, which can also affect pH levels. Additional sampling is needed at this station.

4.6.1.3. *E. coli*

Figure 11 shows the instantaneous *E. coli* counts during summer 2001. The spike that occurred on August 18 may have been the result of the presence of wildlife or waterfowl at the time of sampling, or immediately before sampling.

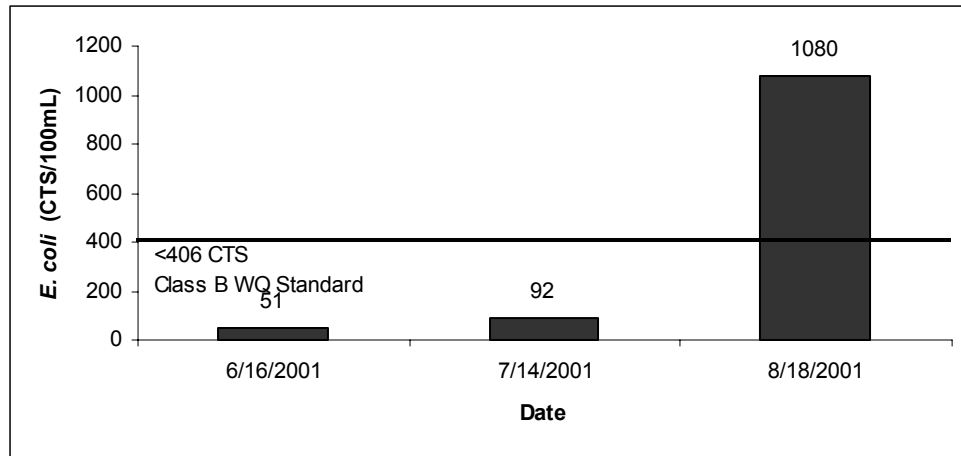


Figure 11. *E. coli* bacteria counts. Ashuelot River at 18-Ash, Route 101, Keene, NH. VRAP, Year 2001.

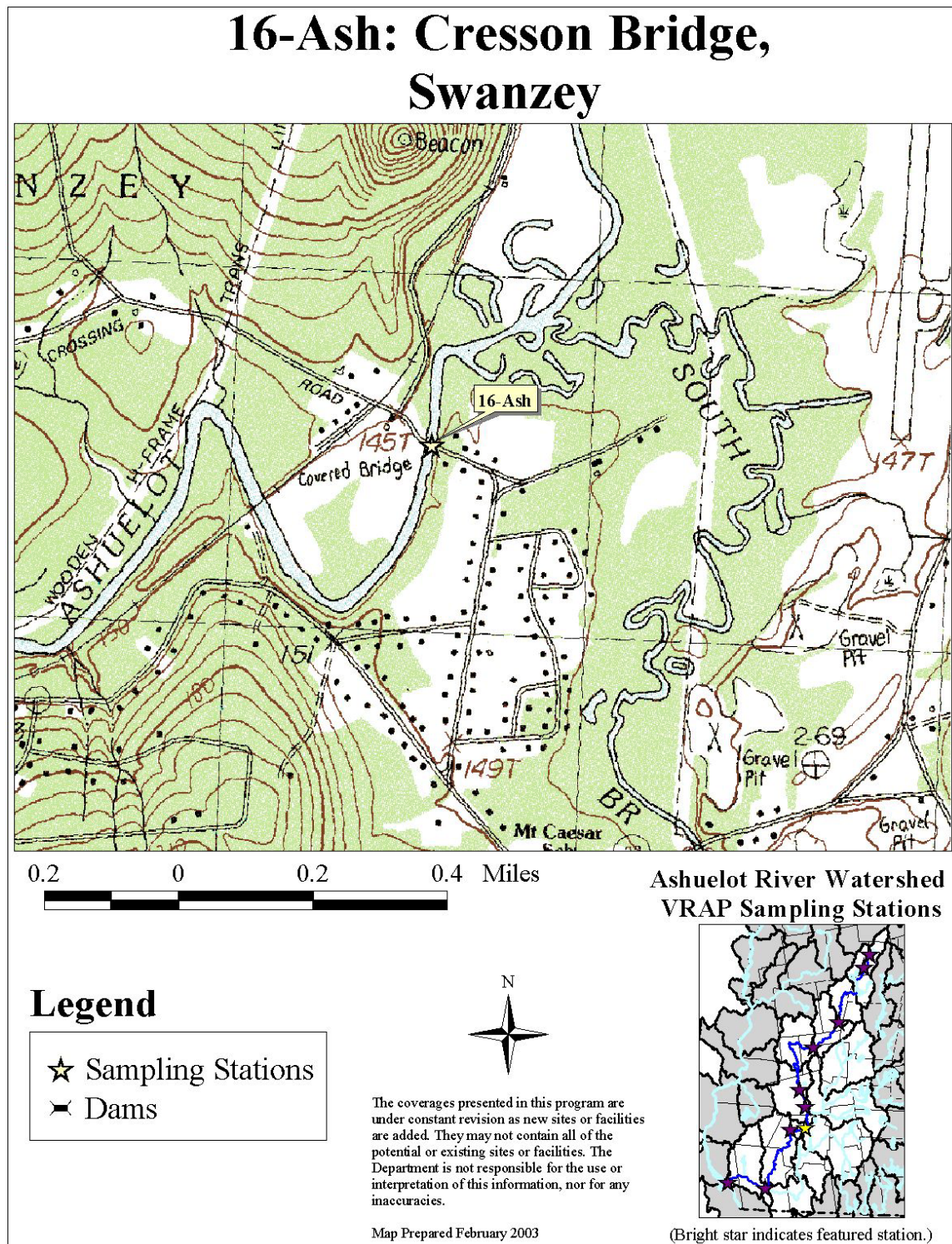
4.6.2. Recommendations

- **Baseline Monitoring:** Volunteers are encouraged to continue sampling for all parameters, especially DO and pH, at this station. More information in the baseline data set will allow for a better understanding of the variations that the river encounters during the year. In addition, this will allow for better documentation of water quality, as related to New Hampshire surface water quality standards.

For an increased understanding of water quality conditions at the time of sampling, volunteers should remember to be specific about the weather conditions and other characteristics of the sampling station.

- *E. coli:* Continued *E. coli* sampling at this station is encouraged, as *E. coli* can influence the recreational use of the river. Therefore it is important to monitor *E. coli*, especially where swimming might be expected. Volunteers should strive to collect at least three samples during a 60-day period, which allows the NHDES to determine the geometric mean of *E. coli*. A geometric mean is a type of average that better describes *E. coli* levels relative to the natural characteristics of *E. coli* in water.
- *Dissolved Oxygen:* Measurements should continually be made at this station on a routine basis. This will help document variations in the river. As previously stated, there are criteria for both concentration **and** saturation that must be met before the river can be considered as meeting DO standards. Volunteers are encouraged to measure DO early in the early morning and during the mid-afternoon hours. This could be done by using a Hydrolab® DataSonde 4a multiprobe, which is an instrument that can collect data at specific time intervals (e.g., every 1-hour). The instrument can be put in the stream and left alone for a period of several days. The use of this instrument is dependent upon availability, and requires coordination with DES.

4.7. 16-Ash: Cresson Bridge, Swanzey, NH



4.7.1. Results and Discussion

Six measurements were made in the field for pH and conductivity, while five measurements were made for dissolved oxygen (DO) concentration, and three for turbidity and DO saturation using handheld meters (Table 7). Four samples were collected for *E. coli* bacteria, total phosphorus (TP), metals, and chloride. All measurements and samples met the Quality Assurance and Quality Control (QA/QC) requirements. Three pH measurements were below the Class B surface water quality standards. One measurement for DO % saturation was lower than 75%, but this does not necessarily indicate a DO problem (see explanation in Section 4.7.1.1, below).

Table 7. Monitoring Summary: 16-Ash. VRAP, Year 2001.

Parameter	Samples Collected	Samples Meeting QA/QC Requirements	Acceptable Samples Not Meeting State Criteria	Data Range	Standards*
DO (mg/L)	5	5	0	6.21 - 9.2	>5
DO (% sat.)	3	3	1	70.8 - 85.3	>75
pH (std. units)	6	6	3	6.19 - 6.69	6.5-8.0
Turbidity (NTU)	3	3	0	0.9 - 1.9	<10 above background
Conductivity (µmho/cm)	6	6	0	33.1 - 199.6	NA
<i>E. coli</i> (CTS/100mL)	4	4	0	33 - 140	<406
Total Phosphorus (mg/L)	4	4	0	0.038 - 0.154	NA
Cadmium (µg/L)	4	4	0	<0.25	<0.95
Copper (µg/L)	4	4	0	<2.5	<3.6
Lead (µg/L)	4	4	0	<0.5 - 2.58	<14
Zinc (µg/L)	4	4	0	<9 - 11	<36.2
Chloride (µg/L)	4	4	0	15 - 30	<860,000

*Abbreviated standard values have been used in this table for quick reference. Please see Env-Ws 1700 and RSA 485-A:8 for complete Surface Water Quality Regulations.

4.7.1.1. Dissolved Oxygen

Figure 12 shows dissolved oxygen concentration and water temperature during 2001. Levels of DO sustained above the standards are considered adequate for wildlife populations and other desirable water quality conditions. The Class B New Hampshire surface water quality standards for DO include a minimum concentration of 5.0 mg/L **and** a minimum daily average of 75 % of saturation. In other words, there are criteria for

both concentration and saturation that must be met before the river can be considered as meeting DO standards.

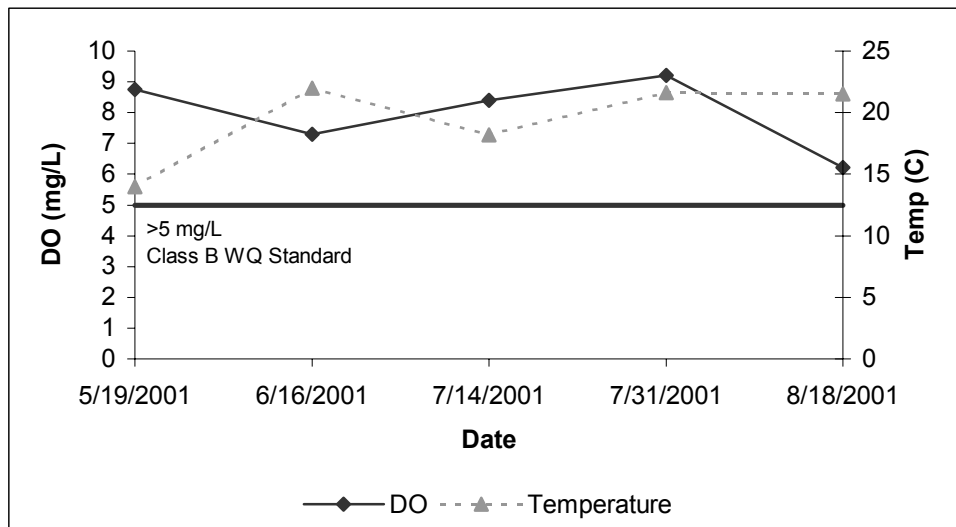


Figure 12. Dissolved Oxygen (DO) Concentration vs. Temperature. Ashuelot River at 16-Ash, Cresson Bridge, Swanzey, NH. VRAP, Year 2001.

4.7.1.2. pH

The pH at this location, ranging from 6.19 to 6.69, was measured below the state standard on three of six monitoring dates. Station conditions are considered along with pH measurements because of the narrative portion of the pH standard. If the sampling location is influenced by natural conditions, low pH measurements are not considered a violation of surface water quality standards. RSA 485-A:8 states that pH of Class B waters *shall be between 6.5 and 8.0, except when due to natural causes*. The pH of surface waters can be affected by soil, subsurface bedrock, and wetlands near the river or stream. In addition, rain and snow falling in New Hampshire is relatively acidic, which can also affect pH levels. Additional sampling is needed at this station.

4.7.1.3. *E. coli*

Figure 13 shows the instantaneous *E. coli* counts during summer 2001. Volunteer sampling since 1998 has indicated that elevated bacteria levels in the Ashuelot River are usually associated with rain events, which has prompted an interest among volunteers to better understand the relationship between rain and bacteria levels.

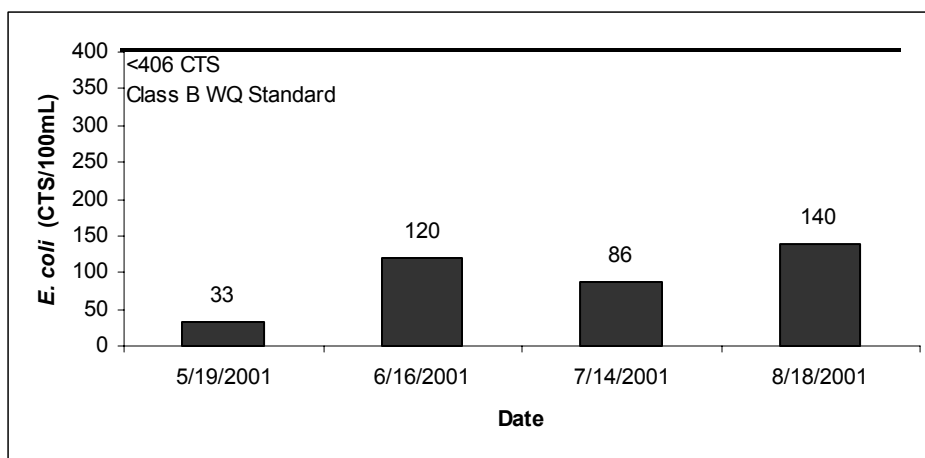


Figure 13. *E. coli* bacteria counts. Ashuelot River at 16-Ash, Cresson Bridge, Swanzey, NH. VRAP, Year 2001.

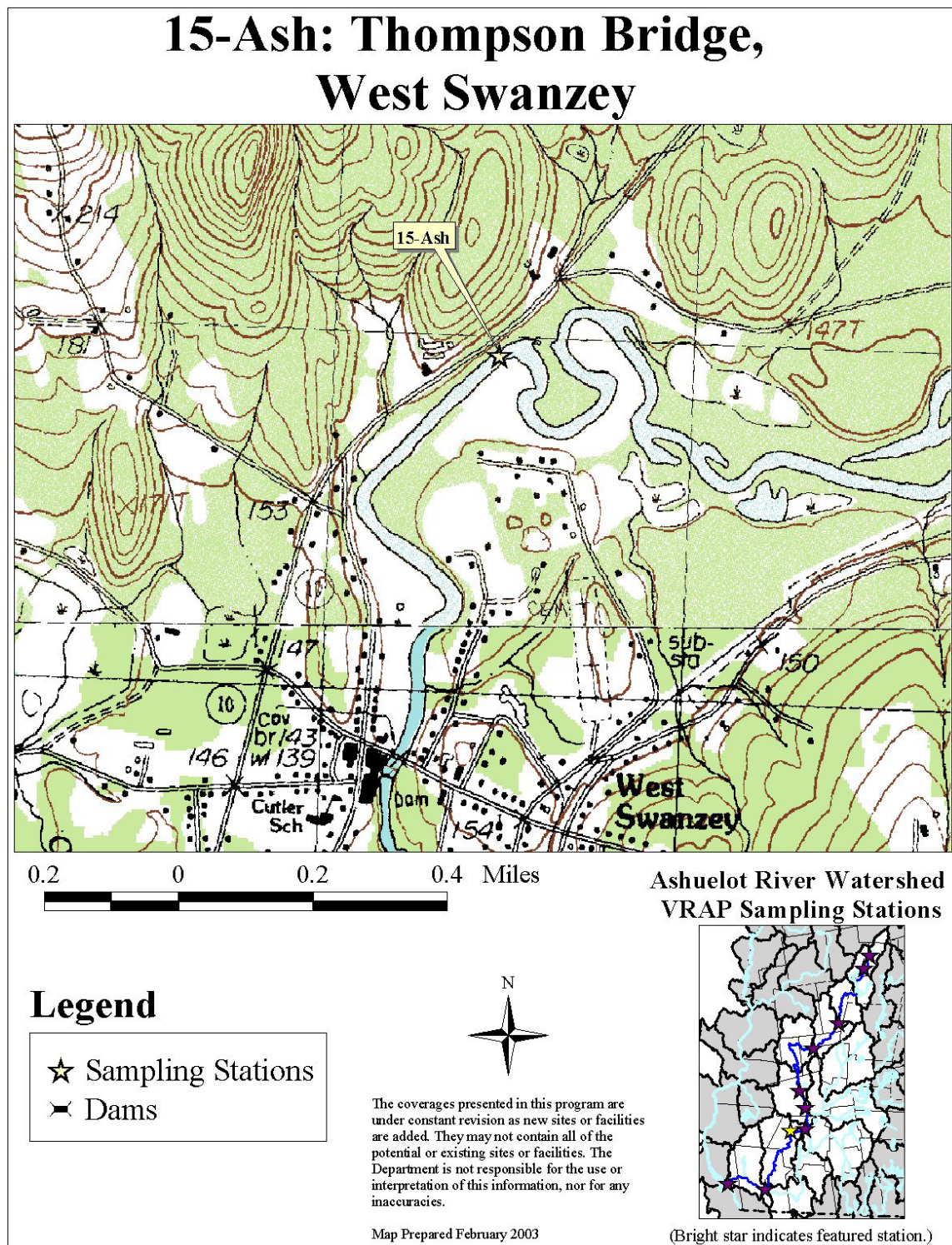
4.7.2. Recommendations

- **Baseline Monitoring:** Volunteers are encouraged to continue sampling for all parameters, especially DO and pH, at this station. More information in the baseline data set will allow for a better understanding of the variations that the river encounters during the year. In addition, this will allow for better documentation of water quality, as related to New Hampshire surface water quality standards.

For an increased understanding of water quality conditions at the time of sampling, volunteers should remember to be specific about the weather conditions and other characteristics of the sampling station.

- *E. coli*: Continued *E. coli* sampling at this station is encouraged, as *E. coli* can influence the recreational use of the river. Therefore it is important to monitor *E. coli*, especially where swimming might be expected. Volunteers should strive to collect at least three samples during a 60-day period, which allows the NHDES to determine the geometric mean of *E. coli*. A geometric mean is a type of average that better describes *E. coli* levels relative to the natural characteristics of *E. coli* in water.
- **Dissolved Oxygen:** Measurements should continually be made at this station on a routine basis. This will help document variations in the river. As previously stated, there are criteria for both concentration **and** saturation that must be met before the river can be considered as meeting DO standards. Volunteers are encouraged to measure DO early in the early morning and during the mid-afternoon hours. This could be done by using a Hydrolab® DataSonde 4a multiprobe, which is an instrument that can collect data at specific time intervals (e.g., every 1-hour). The instrument can be put in the stream and left alone for a period of several days. The use of this instrument is dependent upon availability, and requires coordination with DES.

4.8. 15-Ash: Thompson Bridge, West Swanzey, NH



4.8.1. Results and Discussion

Five measurements were made in the field dissolved oxygen (DO) concentration and conductivity, while six measurements were made for pH, and three for turbidity using handheld meters (Table 8). Four samples were collected for *E. coli* bacteria, total phosphorus (TP), metals, and chloride. All measurements and samples met the Quality Assurance and Quality Control (QA/QC) requirements. One pH measurement was below the Class B surface water quality standards. The DO concentration data do not show any apparent DO problems, but these data alone do not accurately characterize DO relative to the surface water quality standards (see explanation in Section 4.8.1.1, below).

Table 8. Monitoring Summary: 15-Ash. VRAP, Year 2001.

Parameter	Samples Collected	Samples Meeting QA/QC Requirements	Acceptable Samples Not Meeting State Criteria	Data Range	Standards*
DO (mg/L)	5	5	0	6.7 - 11.5	>5
DO (% sat.)	0	0	0	NA	>75
pH (std. units)	6	6	1	6.44 - 6.85	6.5-8.0
Turbidity (NTU)	3	3	0	1.5 - 2	<10 above background
Conductivity (µmho/cm)	5	5	0	34.5 - 143.3	NA
<i>E. coli</i> (CTS/100mL)	4	4	0	19 - 176	<406
Total Phosphorus (mg/L)	4	4	0	0.039 - 0.162	NA
Cadmium (µg/L)	4	4	0	<0.25	<0.95
Copper (µg/L)	4	4	1	<2.5 - 6.29	<3.6
Lead (µg/L)	4	4	0	<0.5 - 2.12	<14
Zinc (µg/L)	4	4	0	<9 - 9	<36.2
Chloride (µg/L)	4	4	0	15 - 35	<860,000

*Abbreviated standard values have been used in this table for quick reference. Please see Env-Ws 1700 and RSA 485-A:8 for complete Surface Water Quality Regulations.

4.8.1.1. Dissolved Oxygen

Figure 14 shows dissolved oxygen concentration and water temperature during 2001. Levels of DO sustained above the standards are considered adequate for wildlife populations and other desirable water quality conditions. The Class B New Hampshire

surface water quality standards for DO include a minimum concentration of 5.0 mg/L **and** a minimum daily average of 75 % of saturation. In other words, there are criteria for both concentration and saturation that must be met before the river can be considered as meeting DO standards.

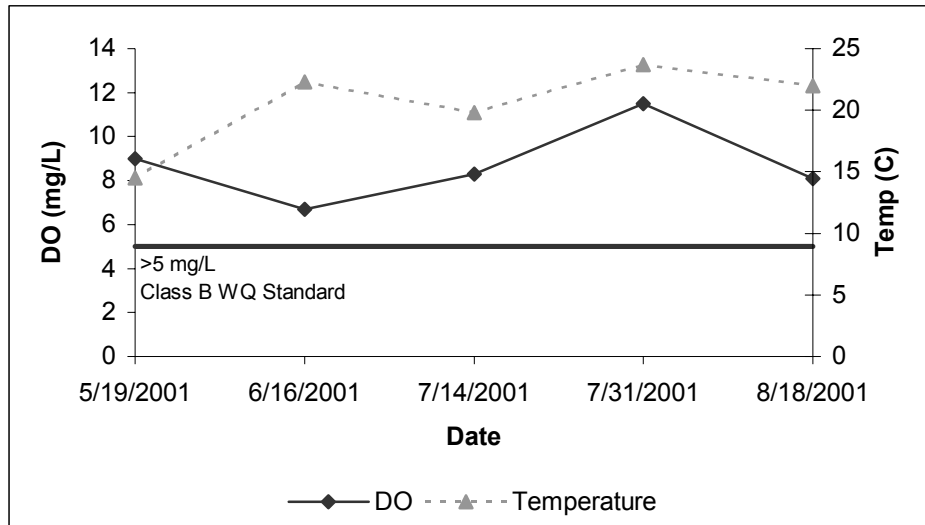


Figure 14. Dissolved Oxygen (DO) Concentration vs. Temperature. Ashuelot River at 15-Ash, Thompson Bridge, West Swanzey, NH. VRAP, Year 2001.

4.8.1.2. pH

The pH at this location, ranging from 6.44 to 6.85, was measured below the state standard on one of six monitoring dates. Station conditions are considered along with pH measurements because of the narrative portion of the pH standard. If the sampling location is influenced by natural conditions, low pH measurements are not considered a violation of surface water quality standards. RSA 485-A:8 states that pH of Class B waters *shall be between 6.5 and 8.0, except when due to natural causes*. The pH of surface waters can be affected by soil, subsurface bedrock, and wetlands near the river or stream. In addition, rain and snow falling in New Hampshire is relatively acidic, which can also affect pH levels. Additional sampling is needed at this station.

4.8.1.3. E. coli

Figure 15 shows the instantaneous *E. coli* counts during summer 2001.

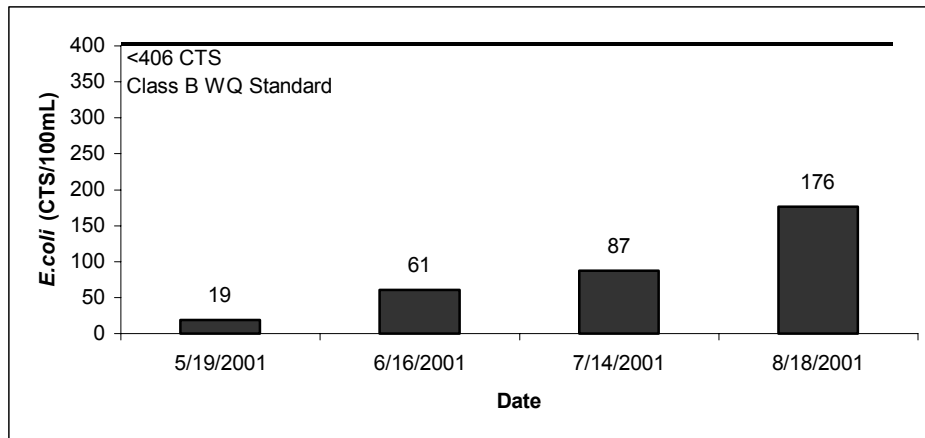


Figure 15. *E. coli* bacteria counts. Ashuelot River at 15-Ash, Thompson Bridge, West Swanzey, NH. VRAP, Year 2001.

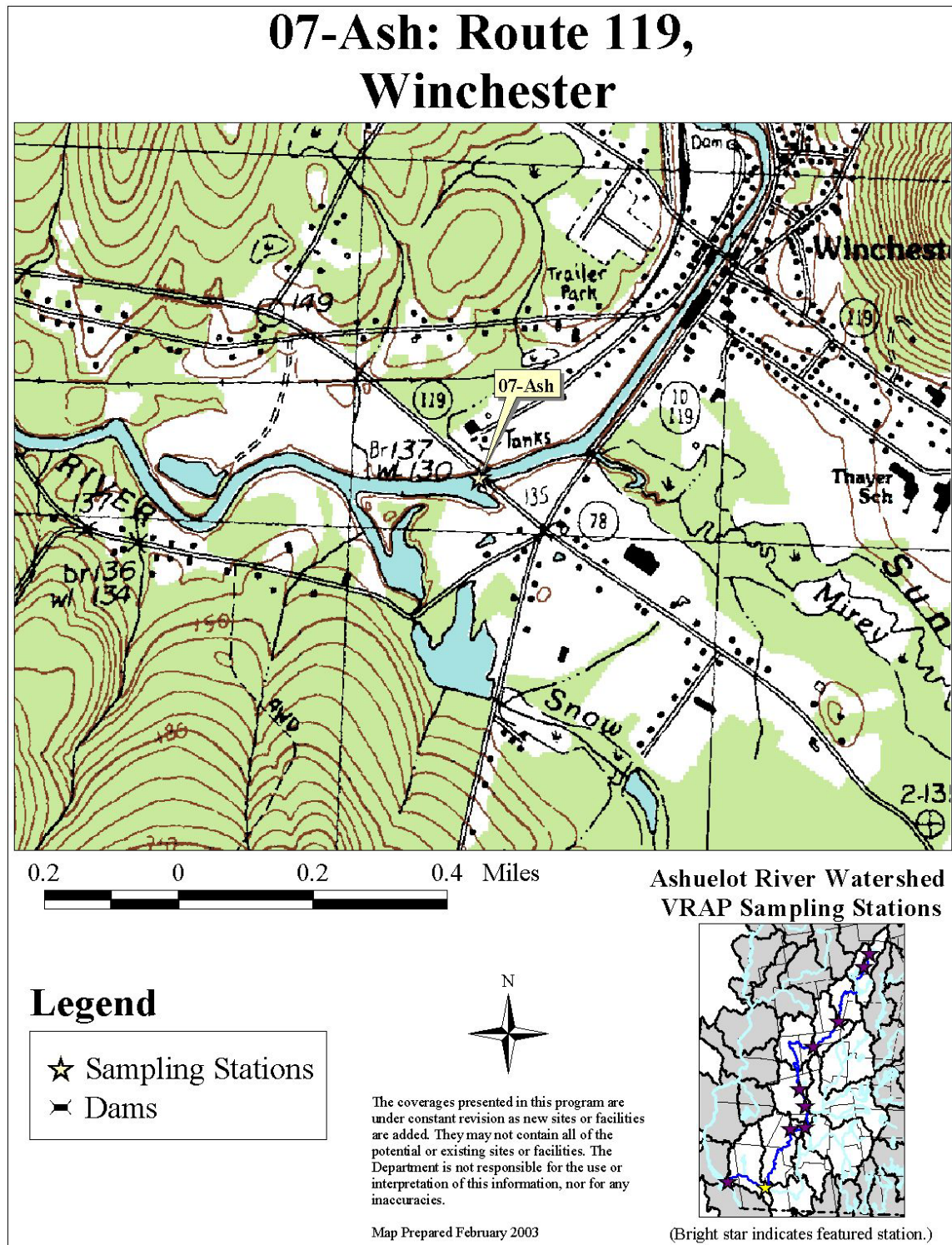
4.8.2. Recommendations

- **Baseline Monitoring:** Volunteers are encouraged to continue sampling for all parameters, especially DO and pH, at this station. More information in the baseline data set will allow for a better understanding of the variations that the river encounters during the year. In addition, this will allow for better documentation of water quality, as related to New Hampshire surface water quality standards.

For an increased understanding of water quality conditions at the time of sampling, volunteers should remember to be specific about the weather conditions and other characteristics of the sampling station.

- ***E. coli*:** Continued *E. coli* sampling at this station is encouraged, as *E. coli* can influence the recreational use of the river. Therefore it is important to monitor *E. coli*, especially where swimming might be expected. Volunteers should strive to collect at least three samples during a 60-day period, which allows the NHDES to determine the geometric mean of *E. coli*. A geometric mean is a type of average that better describes *E. coli* levels relative to the natural characteristics of *E. coli* in water.
- **Dissolved Oxygen:** Measurements should continually be made at this station on a routine basis. This will help document variations in the river. As previously stated, there are criteria for both concentration **and** saturation that must be met before the river can be considered as meeting DO standards. Volunteers are encouraged to measure DO early in the early morning and during the mid-afternoon hours. This could be done by using a Hydrolab® DataSonde 4a multiprobe, which is an instrument that can collect data at specific time intervals (e.g., every 1-hour). The instrument can be put in the stream and left alone for a period of several days. The use of this instrument is dependent upon availability, and requires coordination with DES.

4.9. 07-Ash: Route 119, Winchester, NH



4.9.1. Results and Discussion

Five measurements were made in the field dissolved oxygen (DO) concentration and conductivity, while six measurements were made for pH, and three for turbidity using handheld meters (Table 9). Four samples were collected for *E. coli* bacteria, total phosphorus (TP), metals, and chloride. All measurements and samples met the Quality Assurance and Quality Control (QA/QC) requirements. One pH measurement and two copper measurements were below the Class B surface water quality standards. The DO concentration data do not show any apparent DO problems, but these data alone do not accurately characterize DO relative to the surface water quality standards (see explanation in Section 4.9.1.1, below).

Table 9. Monitoring Summary: 07-Ash. VRAP, Year 2001.

Parameter	Samples Collected	Samples Meeting QA/QC Requirements	Acceptable Samples Not Meeting State Criteria	Data Range	Standards*
DO (mg/L)	5	5	0	7.6 - 12.1	>5
DO (% sat.)	0	0	0	N/A	>75
pH (std. units)	6	6	1	6.34 - 7.49	6.5-8.0
Turbidity (NTU)	3	3	0	1 - 1.6	<10 above background
Conductivity (µmho/cm)	5	5	0	36 - 156.1	NA
<i>E. coli</i> (CTS/100mL)	4	4	0	20 - 70	<406
Total Phosphorus (mg/L)	4	4	0	0.021 - 0.072	NA
Cadmium (µg/L)	4	4	0	<0.25	<0.95
Copper (µg/L)	4	4	2	<2.5 - 4.79	<3.6
Lead (µg/L)	4	4	0	<0.5 - 2.33	<14
Zinc (µg/L)	4	4	0	<9 - 12	<36.2
Chloride (µg/L)	4	4	0	15 - 25	<860,000

*Abbreviated standard values have been used in this table for quick reference. Please see Env-Ws 1700 and RSA 485-A:8 for complete Surface Water Quality Regulations.

4.9.1.1. Dissolved Oxygen

Figure 16 shows dissolved oxygen concentration and water temperature during 2001. Levels of DO sustained above the standards are considered adequate for wildlife populations and other desirable water quality conditions. The Class B New Hampshire

surface water quality standards for DO include a minimum concentration of 5.0 mg/L **and** a minimum daily average of 75 % of saturation. In other words, there are criteria for both concentration and saturation that must be met before the river can be considered as meeting DO standards.

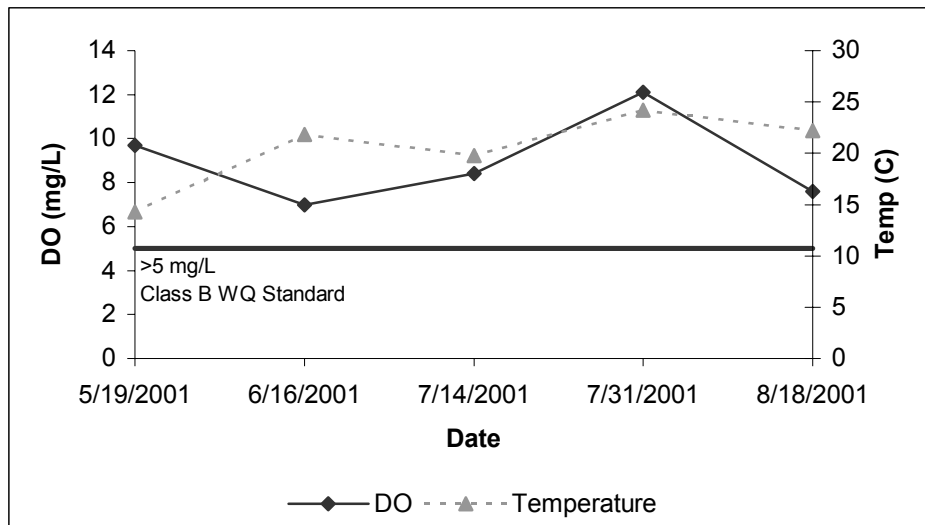


Figure 16. Dissolved Oxygen (DO) Concentration vs. Temperature. Ashuelot River at 07-Ash, Route 119, Winchester, NH. VRAP, Year 2001.

4.9.1.2. pH

The pH at this location, ranging from 6.34 to 7.49, was measured below the state standard on one of six monitoring dates. Station conditions are considered along with pH measurements because of the narrative portion of the pH standard. If the sampling location is influenced by natural conditions, low pH measurements are not considered a violation of surface water quality standards. RSA 485-A:8 states that pH of Class B waters *shall be between 6.5 and 8.0, except when due to natural causes*. The pH of surface waters can be affected by soil, subsurface bedrock, and wetlands near the river or stream. In addition, rain and snow falling in New Hampshire is relatively acidic, which can also affect pH levels. Additional sampling is needed at this station.

4.9.1.3. *E. coli*

Figure 17 shows the instantaneous *E. coli* counts during summer 2001.

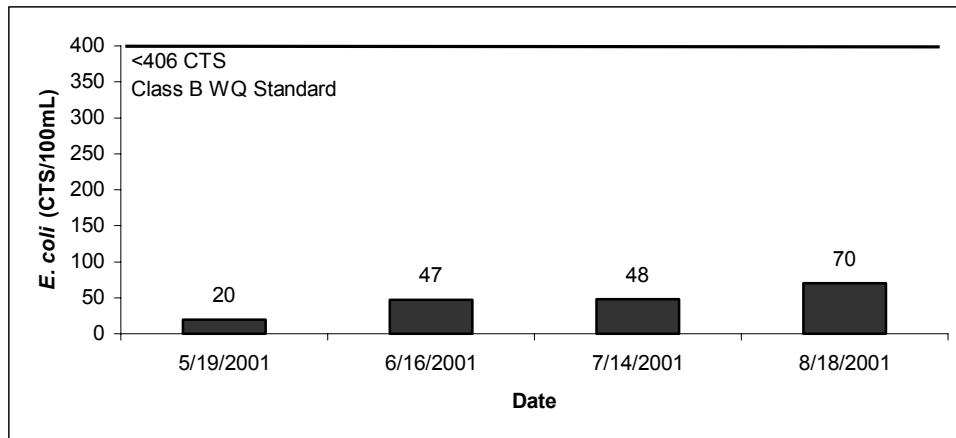


Figure 17. *E. coli* bacteria counts. Ashuelot River at 07-Ash, Route 119, Winchester, NH. VRAP, Year 2001.

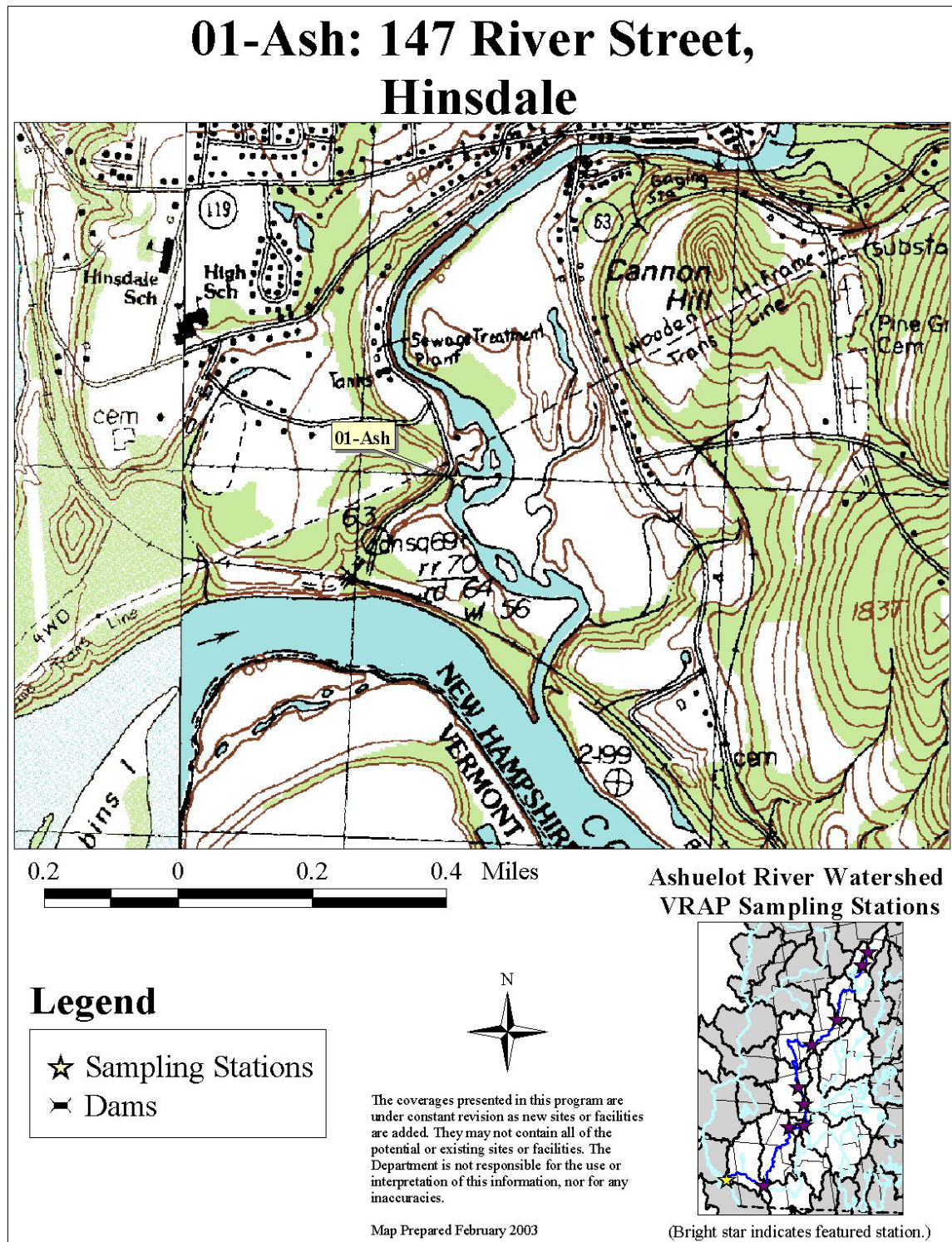
4.9.2. Recommendations:

- **Baseline Monitoring:** Volunteers are encouraged to continue sampling for all parameters, especially DO and pH, at this station. More information in the baseline data set will allow for a better understanding of the variations that the river encounters during the year. In addition, this will allow for better documentation of water quality, as related to New Hampshire surface water quality standards.

For an increased understanding of water quality conditions at the time of sampling, volunteers should remember to be specific about the weather conditions and other characteristics of the sampling station.

- ***E. coli*:** Continued *E. coli* sampling at this station is encouraged, as *E. coli* can influence the recreational use of the river. Therefore it is important to monitor *E. coli*, especially where swimming might be expected. Volunteers should continue to collect at least three samples during a 60-day period, which allows the NHDES to determine the geometric mean of *E. coli*. A geometric mean is a type of average that better describes *E. coli* levels relative to the natural characteristics of *E. coli* in water.
- **Dissolved Oxygen:** Measurements should continually be made at this station on a routine basis. This will help document variations in the river. As previously stated, there are criteria for both concentration **and** saturation that must be met before the river can be considered as meeting DO standards. Volunteers are encouraged to measure DO early in the early morning and during the mid-afternoon hours. This could be done by using a Hydrolab® DataSonde 4a multiprobe, which is an instrument that can collect data at specific time intervals (e.g., every 1-hour). The instrument can be put in the stream and left alone for a period of several days. The use of this instrument is dependent upon availability, and requires coordination with DES.

4.10. 01-Ash: 147 River Street, Hinsdale, NH



4.10.1. Results and Discussion

Seven measurements were made in the field for dissolved oxygen (DO) concentration and pH, while five measurements were made for conductivity and four for turbidity using handheld meters (Table 10). Six samples were collected for *E. coli* bacteria, four samples were collected for total phosphorus (TP), and five samples were collected for metals and chloride. All measurements and samples met the Quality Assurance and Quality Control (QA/QC) requirements. Three pH measurements were below the Class B surface water quality standards. The DO concentration data do not show any apparent DO problems, but these data alone do not accurately characterize DO relative to the surface water quality standards (see explanation in Section 4.10.1.1, below).

Table 10. Monitoring Summary: 01-Ash. VRAP, Year 2001

Parameter	Samples Collected	Samples Meeting QA/QC Requirements	Acceptable Samples Not Meeting State Criteria	Data Range	Standards*
DO (mg/L)	7	7	0	8 - 10.7	>5
DO (% sat.)	0	0	0	N/A	>75
pH (std. units)	7	7	3	6.39 - 7.97	6.5-8.0
Turbidity (NTU)	4	4	0	0.9 - 1.3	<10 above background
Conductivity (µmho/cm)	5	5	0	36.6 - 146.3	NA
<i>E. coli</i> (CTS/100mL)	6	6	0	35 - 100	<406
Total Phosphorus (mg/L)	4	4	0	0.018 - 0.056	NA
Cadmium (µg/L)	5	5	0	<0.25	<0.95
Copper (µg/L)	5	5	0	<2.5 - 2.91	<3.6
Lead (µg/L)	5	5	0	<0.5 - 2.57	<14
Zinc (µg/L)	5	5	0	<9	<36.2
Chloride (µg/L)	5	5	0	15 - 30	<860,000

*Abbreviated standard values have been used in this table for quick reference. Please see Env-Ws 1700 and RSA 485-A:8 for complete Surface Water Quality Regulations.

4.10.1.1. Dissolved Oxygen

Figure 18 shows dissolved oxygen concentration and water temperature during 2001. Levels of DO sustained above the standards are considered adequate for wildlife populations and other desirable water quality conditions. The instantaneous DO standard

(5.0 mg/L) was not met on several occasions, which indicates a potential problem. The Class B New Hampshire surface water quality standards for DO include a minimum concentration of 5.0 mg/L **and** a minimum daily average of 75 % of saturation. In other words, there are criteria for both concentration and saturation that must be met before the river can be considered as meeting DO standards.

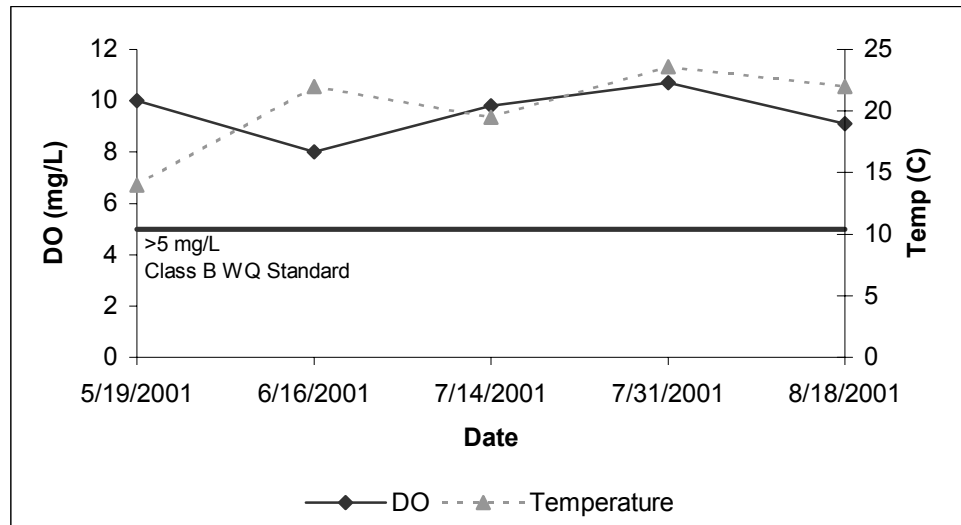


Figure 18. Dissolved Oxygen (DO) Concentration vs. Temperature. Ashuelot River at 01-Ash, 147 River Street, Hinsdale, NH. VRAP, Year 2001.

4.10.1.2. pH

The pH at this location, ranging from 6.39 to 7.97, was measured below the state standard on three of seven measurements. Station conditions are considered along with pH measurements because of the narrative portion of the pH standard. If the sampling location is influenced by natural conditions, low pH measurements are not considered a violation of surface water quality standards. RSA 485-A:8 states that pH of Class B waters *shall be between 6.5 and 8.0, except when due to natural causes*. The pH of surface waters can be affected by soil, subsurface bedrock, and wetlands near the river or stream. In addition, rain and snow falling in New Hampshire is relatively acidic, which can also affect pH levels. Additional sampling is needed at this station.

4.10.1.3. *E. coli*

Figure 19 shows the instantaneous *E. coli* counts during summer 2001.

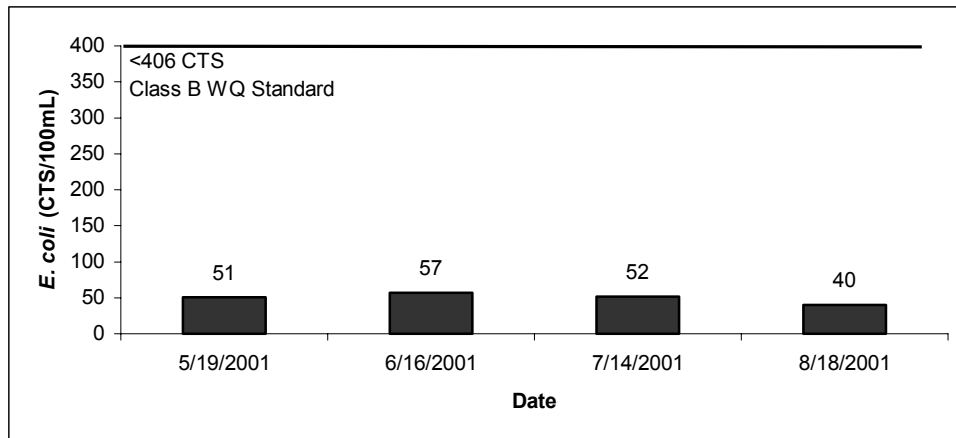


Figure 19. *E. coli* Bacteria Counts. Ashuelot River at 01-Ash, 147 River Street, Hinsdale, NH. VRAP, Year 2001.

4.10.2. Recommendations

- **Baseline Monitoring:** Volunteers are encouraged to continue sampling for all parameters, especially DO and pH, at this station. More information in the baseline data set will allow for a better understanding of the variations that the river encounters during the year. In addition, this will allow for better documentation of water quality, as related to New Hampshire surface water quality standards.

For an increased understanding of water quality conditions at the time of sampling, volunteers should remember to be specific about the weather conditions and other characteristics of the sampling station.

- ***E. coli*:** Continued *E. coli* sampling at this station is encouraged, as *E. coli* can influence the recreational use of the river. Therefore it is important to monitor *E. coli*, especially where swimming might be expected. Volunteers should strive to collect at least three samples during a 60-day period, which allows the NHDES to determine the geometric mean of *E. coli*. A geometric mean is a type of average that better describes *E. coli* levels relative to the natural characteristics of *E. coli* in water.
- **Dissolved Oxygen:** Measurements should continually be made at this station on a routine basis. This will help document variations in the river. As previously stated, there are criteria for both concentration **and** saturation that must be met before the river can be considered as meeting DO standards. Volunteers are encouraged to measure DO early in the early morning and during the mid-afternoon hours. This could be done by using a Hydrolab® DataSonde 4a multiprobe, which is an instrument that can collect data at specific time intervals (e.g., every 1-hour). The instrument can be put in the stream and left alone for a period of several days. The use of this instrument is dependent upon availability, and requires coordination with DES.

Appendix A:

Ashuelot River VRAP 2001
Monitoring Stations

Appendix B:

Ashuelot River VRAP 2001
Monitoring Results

Appendix C:

VRAP 2001 Parameter Descriptions
and NH Surface Water Quality Standards

Appendix D:

Ashuelot River
VRAP 2001 River Graphs

Appendix E:

VRAP 2001 Field Sampling Protocols